

AMERICAN WOMEN OF SCIENCE SINCE 1900

TIFFANY K. WAYNE



American Women of Science since 1900

American Women of Science since 1900

Tiffany K. Wayne



Santa Barbara, California • Denver, Colorado • Oxford, England

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Thanks to Kally Keding and Michelle Delgado for tracking down scientists and citations, and handling my last-minute and often confusing research requests with grace and professionalism. Appreciation goes also to all of the scientists who responded to our email queries and provided up-to-date information on their work.

My family has shown unwavering enthusiasm and patience for my often slow-going work. David Wayne has encouraged me in all of my pursuits and has always given me the freedom and the space (mental and physical) to do my work. So many of the women scientists profiled here trace their own passions and interests back to childhood, and I hope that Miles and Lillian—with their love of nature and animals, and their innate curiosity about the world—will read this book and be inspired to hold onto those passions and to continue to dream big.

Introduction

Nineteenth-century astronomer Maria Mitchell noted in an 1875 address to the Association for the Advancement of Women (of which she was the first president) both “how much women need exact science” and “how much science needs women” (Wyer 2001, 3). Her words could not be truer today. Science and technology are more important than ever to our society as we become a postindustrial high-tech “knowledge” society. It is important that science takes women into account, but women want and *need* to participate in the creation of that knowledge as well.

Women have reached the heights of achievement in the sciences and hold some of the most visible positions. Several women scientists now serve as presidents of major research universities, and in 2009, President Barack Obama appointed women scientists as directors of government research agencies such as the U.S. Geological Survey (USGS) and the National Oceanic and Atmospheric Administration (NOAA). Women have soared, so to speak, to the stars with the National Aeronautics and Space Administration (NASA) as astronauts, shuttle pilots, and members of the International Space Station. Women scientists serve on international advisory councils, affecting policy on everything from global warming to public health, and have founded and led biotechnology, pharmaceutical, and computer software companies. Women are professors, deans of medical and engineering schools, directors of research centers, inventors, and Nobel Prize laureates. A girl growing up in the twenty-first century will seem to have no lack of role models, no limits to her own interests and pursuits.

The history of women in science, however, is the history of not only individual achievement, but of social attitudes, institutional barriers, and legislative and policy initiatives. It is important to realize that access, beginning with the early education and recruitment of girls and young women into the sciences, is the first step to women’s success in the sciences. Women have fought hard for that access and for opportunities for gainful employment, confronting the attitudes of employers, coworkers, family members, and society at large, many of whom have been

resistant to change. From the belief that women are not as interested or as capable in science as men, to society's inability (or refusal) to create family-friendly workplaces, women have been engaged in a century-long struggle for access to education and careers in the sciences, technology, engineering, and mathematics (collectively known as "STEM").

While individual women have achieved the pinnacles of success, women as a group are still underrepresented in professional recognitions, such as with membership in the National Academy of Science and the National Academy of Engineering. In 2009, for example, only 11 women out of 72 new members were elected to the National Academy of Sciences. Likewise, although several high-profile women have won Nobel Prizes in the sciences—and 2009 was a particularly good year for women, with three American women scientists (and one Israeli woman scientist) named as winners—in the history of the Nobel Prize, only 35 women have won in any category out of a total of 789 prizes awarded; of these 35 women, only 15 have been in the sciences.

The past several decades have seen steady increases in the numbers of women earning science degrees and entering science and engineering professions, but there is still a small percentage of women at the highest levels. In 2006, women earned 38.4% of STEM doctorates. The numbers and percentages vary greatly by field, with women earning nearly 50% of Ph.D.s in the biological sciences, 56% in anthropology, and greater than 70% in psychology, the most popular field for women in the sciences. But women earn significantly lower percentages of doctorates in other disciplines, including only 20% of doctorates in combined engineering fields and only 16.6% of Ph.D.s in physics (NSF Table F-2).¹ There are also fewer women the higher up the academic career ladder one goes. In 2006, women made up 31% of all science and engineering faculty, but only 25% of tenured faculty and only 19% of full professors in science and engineering fields (NSF Table H-25).

In her 1988 AAAS presidential address (speaking more than 100 years after Maria Mitchell), **Sheila Widnall** outlined the problem of this "leaky pipeline" that has come to define women's representation in the sciences. The problem begins as early as high school, when boys and girls still have nearly equal interests and grades in subjects such as math. By the end of high school, boys will slightly

¹Note that these numbers include only Ph.D.s, or research based fields, and do not include professional degrees of M.D., D.D.S., D.Pharm., or Psy.D.; nor do they include second doctorates, so that persons changing or combining fields may only be counted in the first field. It is worth noting that inclusion of these other degrees and occupations might significantly alter the overall numbers of women in science related fields. See notes on "Survey of Earned Doctorates" at <http://www.nsf.gov/statistics/srvydoctorates/>.

outnumber girls in completion of higher-level mathematics courses, but the first major split occurs when choosing a college major, with nearly three times as many boys selecting science and engineering paths. A high percentage of women who do major in STEM subjects will complete their degrees and go on for a master's degree, but another drop or split occurs between men and women who continue on for the doctorate. Widnall created a hypothetical scenario (based on the current statistics) in which, out of 2,000 ninth graders (1,000 boys and 1,000 girls) taking comparable high-level mathematics courses, 140 men and 44 women will go on to major in STEM in college; of these, 46 men and 20 women will receive bachelor's degrees, but only 5 men and 1 woman will receive the science or engineering Ph.D. (Widnall 1988). The particular struggles facing women at each of these various stages along the educational and career path are addressed separately in the "Issues" section that follows.

The gender wage gap, glass ceiling, and work/life balance are not just issues for women in the sciences, but affect women across the professions. Women's access, opportunity, and success in the professions is intertwined with other issues in twentieth-century American history, such as social and economic changes, government needs and policy, and the rise of feminism. The larger question of "women in science" is actually twofold; it is the question of women's presence and representation in scientific disciplines and employment, as well as the question of what effect women's presence has on science itself. There are, therefore, both quantitative and qualitative questions to consider when talking about women in the sciences. The statistics show that the numbers of women in STEM disciplines and careers has steadily increased over the course of the twentieth century, but we must also consider how women (and feminism) have changed science itself in terms of the questions asked, the methodologies used, and the new knowledge discovered.

The present volume addresses both aspects of this history and the status of American women in science since 1900 by looking across the century at the work done by more than 500 individual women, and their innovations and contributions, as well as the challenges they faced in pursuing that work. The book includes the following sections: "Issues" (ten essays on specific topics related to American women in science, such as education, employment sectors, minority women, etc.), "Disciplines" (entries on the presence and impact of women in 29 different scientific fields, such as biology, chemistry, physics, etc.), and the biographical entries from A to Z.

This work is an update, revision, and expansion of Martha Bailey's original two-volume biographical dictionaries, *American Women in Science: Volume I* (1994) and *American Women in Science: 1950 to the Present* (1998). The present volume focuses only on those scientists who lived and had significant career

activity after 1900, updating or revising many of Bailey's original entries and adding new entries on significant early women scientists not included in Bailey's original volumes. Carrying the story of American women in science forward, this volume also updates the career information and accomplishments of many scientists still working since Bailey's report of 1998, and adds entries on a new generation of scientists emerging in the late twentieth and early twenty-first centuries.

Reaching back to the nineteenth century, Bailey included many more women who were not necessarily professionally trained as scientists or did not conduct scientific research, but who *supported* scientific work through writing, indexing, cataloging, or popularizing scientific information. In preparing the present volume, however, I eliminated many entries on women who were certainly pioneers in their fields, but who did not hold regular positions as researchers or teachers of science; these were usually in fields opened to and heavily dominated by women in the late nineteenth and early twentieth centuries, such as nutrition, botany, ornithology, and nature writing and illustrating. Women in the earlier part of the century often had more eclectic careers than their later counterparts—they combined research and travel (often self-funded) with writing, illustrating, and teaching, not only in colleges or universities, but in public schools as well. Many (although not all) women of that crucial turn-of-the-century era did gain access to higher education, but still were not always able (or chose not) to secure permanent, formal, or regular employment. In some cases, I eliminated entries for which there simply was not enough specific career information available. And although I cut out much of the personal information Bailey had collected for the original volumes, some of that information on individual women's experiences of combining work and family life, advice to young women scientists, and specific instances of discrimination or other bias over the course of their careers has made its way into my summaries in the "Issues" and "Disciplines" sections of this book. I refer readers to Bailey's *Volume I* for a more thorough overview of women's roles in the scientific disciplines in the nineteenth and early twentieth centuries and, although our projects and purposes were originally quite different, I am indebted to her recovery of and preliminary research on many of those early scientists.

The focus in this volume is primarily on women who made significant impacts in their fields and who received professional recognition for their work, whether through career positions and advancement, membership in professional societies, or scientific awards and honors. However, my criteria for inclusion itself was an inexact science, and I also maintained a sampling of early women who worked in less represented fields, even if they did not have significant research contributions (for example, including a few representative women as early astronomers, entomologists, botanists, mathematicians, paleontologists, and geologists). I also sought to emphasize women who accomplished "firsts" in their careers, to

emphasize to readers the relatively recent history in which women scientists have begun to break down the barriers in specific disciplines. I included many women who were the first presidents of professional scientific societies, the first to receive doctorates in specific disciplines, the first faculty members in specific institutions, or women scientists who worked at high levels of government or academia, on presidential councils, cabinets, or as university presidents. In deciding which disciplines to include, I looked to the sections of the National Academy of Sciences; the emphasis, therefore, is on the physical and natural sciences, although some social scientists are included. The resulting list is certainly not inclusive, and undoubtedly there will be names or accomplishments or disciplines I have missed. As with any reference work, the hope is that readers and students will be inspired to further research these and other women in the history of American science.

Although the women scientists profiled here lived and worked within the specific social and political contexts of twentieth-century America, it is worth noting that, in terms of research commitments, career paths and affiliations, and scientific advances, a somewhat false line is drawn between the work of U.S. and non-U.S. scientists. Indeed, many women profiled here participated in projects and professional networks that were international in scope. Non-U.S. women came to the United States for education or jobs, and American women pursued fellowships or visiting appointments abroad. Some of the greatest achievements by individual women scientists of the twentieth century belong to European researchers, such as physicist Marie Curie of France and her daughter, Irène Joliet-Curie, both of whom won Nobel Prizes; English crystallographer Rosalind Franklin; German physicist Lise Meitner; or British primatologist Jane Goodall. While these figures are not included in the present volumes, other foreign-born women who spent the majority of their careers or achieved their highest successes employed in American institutions are included. Of course, women scientists around the world continue to work together through collaboration and through professional organizations that recognize the broader challenges to women's education and advancement in the sciences, regardless of national origin. Many other fine volumes exist that take a broader view of women's scientific contributions and work, either across regional boundaries or with a longer chronological view.

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Issues

History of American Women in Science

The history of American women's contribution to the scientific endeavor is not merely a story of forward progression from exclusion to full participation as equals. Rather, the history of women in science moves from early access and participation as amateurs, to the closing of the professions through specialization and university-based (doctoral-level) scientific endeavor in the late nineteenth and early twentieth centuries, to expanded opportunities for women in education and employment in the latter half of the twentieth century. Likewise, it is a story that is repeated, with some variations, throughout the world, as women's contributions to scientific knowledge vary by country and region as different social and political circumstances influence women's access to education and employment.

In the United States, the scientific revolution of the eighteenth century brought with it a new professional identity for scientists, and much of what had been traditional knowledge and the realm of women (agriculture, animal care, herbs and medicines, care of the sick, and midwifery)—or at least accessible to women as amateur observers and recorders of the natural world (through botany, chemistry, and astronomy, for example)—slowly became the realm of self-proclaimed professional scientists and doctors. The professionalization of scientific endeavor led to the exclusion of women justified, ironically, by new scientific studies of the era that proclaimed the physical and intellectual differences of men and women and, not surprisingly, the inferiority of women's bodies and minds.

Although the first scientific organizations and scientific journals (in fields such as natural history, botany, chemistry, and medicine) were founded soon after the American Revolution, the first major professional societies were not founded until the mid-nineteenth century. For example, the American Medical Association (AMA) was founded in 1847, the American Association for the Advancement of Science (AAAS) in 1848, the National Academy of Sciences (NAS) in 1863 (the first female member of the NAS, **Florence Sabin**, was not elected until 1925), and the American

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Physician Florence Sabin was the first woman to hold a full professorship at Johns Hopkins School of Medicine and, in 1925, became the first woman elected to the National Academy of Sciences. (National Library of Medicine)

Museum of Natural History opened in New York in 1869. The nineteenth century was the era of the consolidation of scientific interest and specialization, with the American Dental Association in 1859, the American Society of Civil Engineers in 1867, and both the American Physical Society and the Astronomical and Astrophysical Society of America (precursor to today's American Astronomical Society) were founded in 1899. The U.S. government also established its commitment to science by the mid-nineteenth century with the creation not only of the NAS, but also the U.S. Department of Agriculture (USDA), created in 1862, and the U.S. Geological Survey (USGS) in 1879.

These first formal educational programs and professional organizations did not always exclude women specifically, but they were founded at a time

when women were generally excluded from the institutions of higher education necessary for advancement in the professions and thus professional acknowledgment. For example, the Massachusetts Institute of Technology (MIT) was established in 1865 and did not explicitly deny women entry, although its first female student, chemist Ellen Swallow Richards, was not admitted until 1870 and female applicants were not regularly admitted until 1883. Richards, indeed, had a special role as an early woman at MIT and became the college's first female instructor as well. Some organizations included many "lay" (nonprofessional) members, and were thus more open to practicing female scientists. In 1850, Maria Mitchell, who had been educated by her father and had discovered a comet in 1847, became the first female member of the AAAS. Mitchell became professor of astronomy at Vassar College, and is considered the first professional American woman scientist.

Through the late nineteenth and early twentieth centuries, many women practiced science outside of academia, working as illustrators, specimen collectors, or popular writers on topics such as botany and ornithology. Many more women worked behind the scenes, as lab or research assistants for male professors or as assistants or unpaid collaborators in support of their husbands' higher-profile careers. Still others, having studied science as undergraduates and with or without

Margaret Cavendish

Margaret Lucas Cavendish, Duchess of Newcastle-upon-Tyne (1623–1673) is considered England's first woman scientist and was a prolific writer on topics related to science and natural history. She was one of the earliest women writers to publish under her own name and contributed to some of the key ideas of the scientific revolution, including the separation of religious belief from scientific inquiry, the establishment of a scientific method, and arguments for animal rights.

As a member of “The Newcastle Circle” salon, she debated with some of the most important philosophers of the seventeenth century, including Thomas Hobbes and René Descartes. She promoted her own ideas, sometimes directly challenging other prominent thinkers, through the publication of several works, including *Philosophical Letters: or, Modest Reflections upon some Opinions in Natural Philosophy*, *Philosophical and Physical Opinions*, and *Observations upon Experimental Philosophy*, often sending copies of her books to university scholars. She also published a utopian romance, *The Blazing World*, considered one of the earliest works of science fiction. Cavendish was the first woman allowed to visit meetings of the newly created Royal Society of London, which did not admit women as members until the twentieth century.

advanced degrees, taught science at the high school level or in women's colleges, helping to establishing first-rate programs for women. The first co-educational college was Oberlin College, founded in Ohio in 1833. Oberlin accepted not only female students, but African American students as well, although only certain programs were initially open to women. Swarthmore College was founded in Pennsylvania in 1864 and was also co-educational, and the nineteenth century saw the creation of the “Seven Sisters” East Coast women's colleges—Mount Holyoke (1837), Vassar (1865), Smith (1875), Wellesley (1875), Radcliffe (1879), Bryn Mawr (1885), and Barnard (1889)—several of which were begun as female auxiliaries or annexes to male schools or programs.

The establishment of the land-grant colleges in the Midwest beginning in the mid-nineteenth century also opened up women's access to education in agriculture-related fields such as animal sciences, biology, nutrition, and home economics. And although many women scientists pursued their educations and careers as teachers at women's colleges, some advanced through positions at co-ed and black schools. In 1879, for example, Josephine Silone Yates became the first woman to be appointed professor and head of Natural Sciences at Lincoln University in Missouri.

The first medical colleges were established and the first scientific doctorates were awarded in the mid- to late nineteenth century, securing formal and certificated higher education as the standard for the professional title of “scientist.”

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Women's rights activists and health reformers pushed for women's access to the most prestigious medical colleges and helped create the first women's medical colleges and hospitals. The first woman to earn a medical degree was Elizabeth Blackwell in 1849 (from Geneva College in New York). In 1857, Blackwell opened the New York Infirmary for Women and Children, where she also trained other women physicians. Only 30 years after its founding did the American Medical Association elect its first female member (AMA, "Women Physicians"). By the turn of the century, the first women received advanced degrees in the sciences. By 1889, only 25 American women held doctorates, 6 of them science degrees; within just a decade, by 1900, that number had risen to more than 200 doctorates awarded to women, one-quarter of those in the sciences and mathematics (Rossiter 1982, 35–36).

Bryn Mawr College was the first women's college to offer the Ph.D., and graduates often went on to careers as teachers at the women's colleges. By the early twentieth century, schools such as Mt. Holyoke, Vassar, and Smith had built exceptional undergraduate science programs in fields from astronomy and chemistry to botany and zoology, making science an acceptable course of study for women and training a new generation of women scientists. With heavy teaching and administrative duties, however, the female faculty at women's colleges did not publish as often as male faculty or otherwise achieve recognition as research scientists. It is also notable that female faculty rarely, if ever, married, as combining career and family remained a primary challenge for professional women, including women scientists, throughout the twentieth century.

The situation for women's higher education continued to improve through the early decades of the new century. The 1910s were a historic high for women receiving medical degrees, and the 1920s were the first peak for women receiving other scientific doctorates in the United States. So positive was the outlook for the future of women scientists that the president of Bryn Mawr College declared confidently in 1921 that "the doors of science have been thrown wildly open to women." Indeed, throughout the 1920s, women were earning an average of 50 science doctorates a year, and that number tripled in the 1930s (Rossiter 1982, 35). The number of women earning doctorates in the physical and biological sciences dropped between the 1940s and 1960s, finally climbing again beginning in the 1970s with the advent of modern feminism and policies promoting equity in education and employment.

During and immediately after World War II, the federal government had a new commitment to scientific research in the name of military technology and then the Cold War-era nuclear arms and space exploration races. The new government science mandate, combined with a shortage of men due to the war, provided new opportunities for women scientists and engineers in academic and government

Hedy Lamarr

Austrian-born actress Hedy Lamarr (1913–2000; born Hedwig Eva Maria Kiesler) was a beloved Hollywood star of the mid-twentieth century, but she was also an inventor. Lamarr and her colleague, American composer George Antheil, received a patent in 1942 for their “Secret Communications System,” a method of securing radio transmissions via a special code or frequency shifting between transmitter and receiver that could not be intercepted by enemy forces. They developed the system during World War II as a contribution to efforts to defeat the Nazis, but the system was not put into use by the U.S. military until two decades later, during the Cuban Missile Crisis of the early 1960s. By that time, the patent had expired and neither Lamarr nor Antheil received any compensation for their invention. Lamarr chose acting over inventing, however, and went on to have a successful film career, appearing in dozens of films with the biggest names in Hollywood of the 1940s and 1950s. The transmission technology she helped develop had enormous significance as the basis of later wireless communications systems via cellular phone, modems, faxes, and the Internet. In 1997, Lamarr and Antheil were recognized with a Pioneer Award of the Electronic Frontier Foundation, and Lamarr was the first woman to receive the prestigious BULBIE Gnass Spirit of Achievement Award for inventors.

research positions. In the 1940s and 1950s, women made their mark in medicine as well as in the fields of nuclear science, crystallography, engineering, and aerospace. Although the numbers of women entering science increased exponentially in these years, the overall percentage of women among college students remained low due to the extraordinary number of men receiving degrees through the GI Bill for education for returning veterans. After the war, the numbers of women earning doctorates continued to climb, but the job market for women scientists in the 1950s and 1960s was still difficult, due to social pressures (such as the postwar emphasis on women’s domestic roles) and a decreased labor need (due to the availability of more male scientists), especially in the higher-level research positions. In this social and economic climate, women who held college degrees had a difficult time finding jobs to fit their education, and women who did secure such jobs faced discrimination and challenges specific to the era; for example, in an environment with little social support or even acknowledgement of women’s workplace contributions, there was little social or political attention to issues such as unequal pay or access to childcare.

Still, many women scientists continued to forge ahead during and after the war. Women found careers with government research projects such as U.S. Army nutrition and medical studies, crop and animal studies for the more science-oriented

USDA, and work on the atomic bomb with the Manhattan Project. The federal government funded scientific research for its own projects as well as for academic and industrial or corporate research projects. The World War II-era dislocation of many European scientists, followed by the Cold War emphasis on scientific and technological progress as a sign of political strength (the rise of the “military-industrial complex”), meant that many foreign scientists found their way to the United States for educational and employment opportunities as well.

In the 1960s and 1970s, new social and political concerns about equity brought the Civil Rights Act and the Equal Employment Opportunity Act, which outlawed discrimination, both overt and covert, that had previously been the status quo for women in the workplace. The women’s movement introduced the term “sexism” and pushed for legislation that guaranteed not only equal access (opening up non-traditional fields for women, such as military combat and firefighting) but also equal treatment in educational and employment environments, challenging discriminatory hiring (separate male and female job ads), unequal pay, and sexual harassment, among other issues. These social and political changes also made it more important than ever to track women’s entrance into and progress in different fields of study and employment. By the early 1980s, efforts were made to keep regular statistics on women in science, to track progress (or lack thereof) in concrete numbers and percentages, and to bring wider public awareness to areas where women and minorities were underrepresented. Finally, the women’s movement brought attention to subtler forms of discrimination and their effect on women’s educational and career pursuits. Feminist sociologists and psychologists began to study how gender roles and expectations were ingrained in family dynamics, childrearing practices, elementary school classrooms, and, finally, on the job, all of which discouraged girls and women from, in this case, pursuing science- and technology-related majors and careers in the first place.

By the early 1980s, women reached the point of earning fully half of all undergraduate degrees awarded, and in 2006, women earned close to 58% of bachelor’s degrees in all fields combined (NSF Table C-14). In 2006, women actually earned a slightly higher number of science and engineering bachelor’s degrees than men, but the problem extends beyond the undergraduate years in a phenomenon some have called “the leaky pipeline”; that is, the higher up one moves through the educational and career pipeline, the fewer women are present. Despite equal numbers of women and men receiving science-related bachelor’s degrees, in 2006, women accounted for only 38.4% of combined science and engineering doctorates (NSF Table F-2). (Note that this includes research doctorates only, and NSF science figures do not include the M.D., D.D.S., Psy.D., or D.Pharm. degrees.) Continuing along the career path, women made up only 24% of employed American scientists and engineers in all professions (NSF Table H-7) and 25% of tenure-track faculty

(NSF Table H-25). Even fewer women scientists (19% in 2006) are represented among the highest faculty rank in academia, that of full professor (NSF Table H-25).

Researchers since the 1980s have discussed the source and solutions for educational disparities and established programs to encourage girls and young women to pursue science, engineering, and math majors and careers. While women have gained access to science-related education, and it is no longer socially acceptable or legal to limit the educational or vocational pursuits of girls and women, the subtler forms of discrimination and barriers still remain for women scientists and affect many men as well, such as the tensions between family life and work expectations, lack of affordable childcare, or the need to change the tenure clock in academia. The history of American women in science so far reveals not so much a clear march of progress, but a series of forward movements and continued obstacles, a history still being written.

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Is There a Science Gene?

The debates over sex-based differences when it comes to scientific interest and ability are not new. The scientific revolution of the eighteenth century brought new credibility to explanations for the significance of differences between male and female anatomy, skull size and shape, and brain size, among other anatomical features, as well as the social significance of racial differences. Science, in the name of "nature," has often been used to justify keeping women (and racial minorities) from educational and professional opportunities. As social and educational barriers to women's full participation in science have been removed, the fact remains that there are still fewer female than male scientists. If we have reached a historic moment of both equal access and condemnation of gender discrimination, then how to explain women's continued minority presence in science and engineering careers? The question remains: Can the smaller numbers of women scientists be explained by social factors alone, or are there biological or innate factors to consider? And if there *are* identifiable genetic or neurological differences between the sexes, do such differences, in turn, explain differences in math test scores or, more generally, do they explain anything about ability or aptitude for skills required in the sciences, engineering, and math?

This was the set of questions addressed by Harvard University president Lawrence Summers at a 2005 conference on "Diversifying the Science & Engineering Workforce." While Summers addressed several possibilities to explain the smaller numbers of women in high-level scientific research and faculty positions, the most controversial aspect of his remarks was the suggestion that there are innate differences between the sexes that limit women's interest in and aptitude

for science and math—what he called a “different availability of aptitude at the high end.” Summers specifically addressed the fact that there are fewer women scientists the higher up the professional ladder one climbs, and came up with a formula that accounted for the fact that the top-level scientists (he specifically focused on physics, perhaps the most prestigious scientific discipline precisely because it is seen as so *difficult*, thus requiring some innate talent rather than mere education) are already smarter than the general population, so that *any* differences in aptitude between the sexes among talented individuals will become more apparent the higher one advances. Summers referred to the greater number of male physicists as an “unfortunate truth” that he wished could be explained away as “a serious social problem,” but that must take into account other factors, such as “taste differences between little girls and little boys that are not easy to attribute to socialization.” In other words, if parenting and education have changed to *encourage* more girls into science, and to make opportunities available, why are more girls not *choosing* science as a career path? Summers concluded that, while negative socialization and discrimination still exist, these only compound (rather than explaining away) the basic reality of “intrinsic aptitude, and particularly of the variability of aptitude” (Summers 2005). Summers’s remarks prompted a series of responses from scholars and subsequent conversations and debates that ultimately led to his resignation (WISELI 2009).

The irony is that, while science has been used in the past to limit women’s opportunities, it is more science that is needed to answer the questions. The question of the nature (and significance) of differences between the sexes has been taken up by twentieth-century psychologists, neuroscientists, geneticists, and evolutionary biologists, as well as by social scientists. Not surprisingly, scientists became interested in understanding any potential biological component to scientific ability at the precise moment when women began entering the scientific professions in greater numbers—a case of social concerns guiding research questions. Of course, many of those same women scientists were there to challenge and guide the research being done with their own questions. The main areas of this research have been in questions of genetic, hormonal, neurological, and cognitive differences between the sexes.

Despite the title of this section, there have never been found any *genes* related to spatial reasoning or math skills. Interest in finding a “science gene” dates to a study in the 1970s in which “an X-linked recessive gene was thought to cause sex differences in spatial abilities . . . However, subsequent research, involving larger samples, failed to replicate the initial findings” (Hines 2007, 104). Still, other scientists continue to pursue this line of inquiry and ask how to explain the exceptional case of a mathematical genius, for example, who rises from a negative social, economic, or educational environment with what appears to be innate

talent. One recent researcher suggests that “a role for genes” should not be dismissed as an explanation for scientific or mathematical ability and genius, pointing out that while we regularly look to a biological or genetic basis for diseases or psychological issues, we become defensive over the idea of inquiring into the biological, genetic, or cognitive difference of *sex* (Haier 2007).

While genetics, specifically, has yielded few answers to this question to date, endocrinologists have shown that hormones do affect brains differently, and that a higher presence of male hormones (androgens), beginning prenatally, correlates to greater spatial reasoning. Finding a firm link between sex hormones and spatial reasoning (or verbal or mathematical ability, or IQ) is still an active and controversial area of research. The current research shows that, at most, spatial skills can vary with hormone levels within an individual; that is, they can be affected by changes such as puberty or menstruation, although there is no clear evolutionary advantage for having these different abilities at different times in one’s life or hormonal cycle. Some scientists find the evidence convincing for innate ability, arguing that superior male spatial-reasoning skills may not be significant enough to explain social phenomena, but these sex-based differences do exist across cultures and across time, regardless of education levels. Others point out that it is not the hormones specifically that explain cognitive differences, but rather the activities or experiences that people seek out because of hormones; for example, hormones may predispose a female child (but not *all* female children) to an interest in playing with dolls, which, in turn, may *develop* specific kinds of cognitive and emotional abilities that are then identified as innately “female.” In the end, then, education and environment remain the most important factors, as brains are changed by training and experience (Ceci and Williams 2007).

Thus, hormonal and neurological aspects overlap in explaining more broadly observed sex-based differences. Neuroscience has stepped in with new technologies, such as brain imaging, to track activity in different regions of the brain and to track differences between men’s and women’s brains. Researchers have found that men tend to be more object-oriented and women more language-oriented, but while men and women might use different parts of their brains to problem solve, they are capable of arriving at the same conclusions. Most researchers admit that it is difficult to separate specific skill sets (based on test results or problem-solving techniques) from education and socialization. For example, if differences between boys’ and girls’ math test scores do not appear until high school, are boys’ higher scores explained by innate ability at this higher level, or by compounded negative messages girls have received about their math ability? One study was conducted on men and women who received the same math scores on the SAT and found that their brains did, indeed, function differently while taking the test, even though the scores were the same. The researchers also conducted MRIs on the

students to determine whether there was a sex-dependent correlation between IQ and brain structure. But even when IQ scores were the same for men and women, their brains were still different (Haier 2007, 115; Ceci and Williams 2007).

The question, then, remains as to what difference, if any, sex makes, and what the significance of that difference is. Other scientists have pointed out that if we are interested in determining innate mathematical ability, it would make more sense to break down the specific skill sets involved and assess children when they are younger, since by the time students take the SAT, they are already a self-selected group of college-bound, higher-level students. Some feminist education researchers have pointed out other ways in which test questions and methods favor male students, and ask whether performance on college-entrance exams even has a direct correlation to future success (or failure) in science, technology, and math careers. Research into sex-based brain differences has not been in vain, however. While they may not yet explain science and math ability, such findings may provide insight into sex-based differences in diseases such as Alzheimer's, schizophrenia, or depression (Cahill 2006).

The work of psychologists and social scientists not only adds to but overlaps with biological and neurochemical studies of the brain. Some of the latest research looks at the effect of playing video games, computers, and with Legos and other building toys on boys' spatial reasoning and brain development. But this research brings us back to the question of whether boys play those games *because of* an innate ability, or whether the games *create* the skills. We must also ask whether and how interest in such activities is socially encouraged in boys or, conversely, discouraged in girls. One study found that parents are more likely to set up computers in their sons' rooms, but whether that is because boys are more interested in computers or because parents *expect* sons to be more interested in computers is still up for debate. Psychologists look at behavior differences between boys and girls and ask which skills can be taught or developed regardless of sex.

Feminist psychologists have argued that many theories presented to explain sex-based differences are in fact framed to fit with our social beliefs about *gender*, and that those theories or questions often become circulated as "facts" without critical analysis. For example, sex difference fits into evolutionary psychology (or sociobiology) explanations for why men might need better spatial skills for activities such as hunting, building, or navigating large distances. But there is no acknowledgement that the same or a similar skill set was needed by women to gather, weave, or make weapons (Newcombe 2007). While the questions of genetic, neurological, and cognitive explanations for human behavior are of fascinating interest to researchers and to the general public, many scientists still maintain that most differences, even in research on the youngest babies (such as work done by Harvard psychologist **Elizabeth Spelke**), point to social factors rather than biology (APA Online 2006).

Last, a limited focus on a particular skill set (such as spatial skills or abstract reasoning) as the most important indicator of scientific or mathematical interest or ability precludes inquiry into not only the social and institutional barriers to women in science, technology, engineering, and math (STEM) careers, but also to the importance of other skills necessary for career success. Surely imagination, creative problem solving, written and oral communication skills, persistence and focus, and a range of interpersonal skills needed for working collaboratively on research and mentoring are all just as important factors for success in scientific research and teaching careers, and may be possessed by or nurtured in individuals of either sex.

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The Impact of Feminism on Scientific Research

Not only has feminism challenged the idea of innate differences between the sexes when it comes to technical abilities or interest in math or science, but the steady rise of the numbers of women in scientific professions over the course of the last century has introduced new questions and new research agendas in many fields as well. Different scientific fields have responded to and been affected by the presence of more women scientists, and by the challenges of feminism as a social and political movement over the course of the twentieth century. While academic feminism has had an obvious impact on the social sciences, such as psychology and sociology, the physical or "hard" sciences especially have been seen as gender-neutral realms of knowledge and inquiry. On the contrary, the medical and life sciences have been at the forefront of establishing new findings about the nature of sex and gender. The question of the impact of women and of feminism on science is twofold, then: First, what has been the impact of including women (and gender) as *subjects* of science? Second, what has been the impact of women as *scientists* and of feminism on research? Is there a female, or a feminist, approach to science?

The first feminist intervention into science was to reject the exclusion of women from scientific professions and from participation in the scientific pursuit as researchers and teachers. Early women scientists and reformers pointed out women's limited access to education, institutional support, and jobs, and sought to remedy the situation. Once women entered into the scientific professions, feminist scientists began to question the sexism inherent in the research itself. What they discovered is that science itself has been used to keep women out, to limit their opportunities, and to silence their voices. The greater representation of women in the sciences is a worthy goal, feminists argue, not only as a political commitment to equality, but because women change the very questions asked by science and therefore have an impact on the creation of scientific knowledge.

Historian of science Londa Schiebinger calls "femininity" and science "the historical clash of . . . two cultures," which was epitomized in the Western European and American traditions with the late-eighteenth- and early-nineteenth-century

split between the private realm of the family and the public world of work. The scientific revolution of the Enlightenment paved the way for the professionalization of science and the exclusion of women from higher education and the professions for another century. Besides institutional barriers, women have long faced social pressures and expectations as to which employments are suitable for women; historically, science has not been one of those professions. From the earliest scientific inquiries to the scientific revolution of the mid-eighteenth century and beyond, “men of science held that creative work in the sciences lay *beyond the natural capacities of women*.” One nineteenth-century practitioner defined science as “anti-feminine,” and the scientist as one whose “mind is directed to facts and abstract theories, and not to persons or human interests . . . they have little sympathy with female ways of thought” (Schiebinger 1999, 70–71). In the late nineteenth century (not coincidentally, as women began to gain access to professional and graduate schools), doctors began to warn of the negative effects of rigorous study for women, particularly when women were menstruating or pregnant. Women’s bodies and minds were seen as unsuitable to the scientific pursuit of knowledge; biology was destiny.

Of course, race and racism have also factored into scientific understandings of bodies and minds. Whereas white women in the eighteenth and nineteenth centuries were portrayed as physically fragile and mentally unstable, African Americans (male and female) were seen as physically robust but intellectually inferior, their bodies suited for physical rather than mental labors. Well into the twentieth century and beyond, the very image of the scientist is of one possessing a superior mind that in some ways *transcends* the body—the mad scientist, solitary in his lab, absentminded and detached from social and familial relationships. It has been a long struggle for nonwhites and for women of any race to transcend the belief that they are simply too tied to the needs of their bodies (and their families) to engage in the focused, dedicated work of science. Women scientists themselves, however, have always questioned the professional culture of science, from the view of the scientist himself as a male figure of intellect and authority, to career paths and tenure clocks that ignore family life, to a professional and institutional culture that is organized around the assumptions of male employees.

The goal of feminist science has been not only to expand the numbers of women in specific fields, but to reveal how science itself operates according to certain gendered assumptions. Londa Schiebinger describes the feminist task of the late twentieth and now twenty-first centuries as a shift away from pointing out the flaws and limitations of science, “toward the more positive task of asking what useful changes feminism has brought to science” (Schiebinger 1999, 1). There is no one single way of doing “feminist science,” just as there is no single definition of feminism or feminist goals. Not all feminists are women (many male scientists are concerned with questions of gender, power, and knowledge as well), and not all

women are feminists; therefore, not all women scientists bring a feminist perspective to their work. Feminists may work in all scientific fields and may be interested in different questions. They may (or may not) be particularly interested in how gender functions in the scientific pursuit of knowledge, but many bring questions of sex and gender to their specific fields or disciplines by including women as subjects of study (in medical trials or as interview subjects, for example), including more subjective or qualitative methods in their approach (in the social sciences or through interdisciplinarity), or questioning the bias of gendered language to describe certain scientific processes (whether in animals, plants, or inanimate objects).

Women scientists and engineers have revised the direction and methods of scientific inquiry, often exposing the biases or challenging the very foundations of scientific knowledge in fields from evolutionary biology to medicine, from anthropology to zoology. Some fields have expanded to include specifically women's concerns, for example, research related to women's health and medical treatment. While president of the American Heart Association, **Bernadine Healy** emphasized that heart disease was a leading cause of death in women as well as men; when she was director of the National Institutes of Health, she brought about reforms in the clinical testing of drugs for women and children. Other researchers have focused on women's nutrition, maternal health, and breast cancer. Women



Cardiologist Bernadine Healy has been head of the National Institutes of Health, the American Heart Association, and the American Red Cross. (AP/Wide World Photos)

anthropologists, such as **Margaret Mead**, focused for the first time on women's social and sexual roles, and others looked at the cross-cultural experiences of childbirth and mothering, pointing out that leaving women out of such research skewed our understanding of social and economic life. A similar revolution took place in the study of animals, such as in the work of primatologist **Jeanne Altmann**. The work of primatologists and of evolutionary biologists has pointed out the importance of looking at the intersection of biology and culture to understand gender and sex-specific roles and behaviors.

Feminist theory makes the radical claim that science is not always objective, but is often influenced by social beliefs and goals. Feminist scientists have sought to create new knowledge that complicates our view of humanity and nature, and begins with a critique of traditional research methods and questions that create results that exclude, misrepresent, or disadvantage women. In the name of a pure "masculine" objectivity, feminists argue, science as a discipline has rejected "feminine" or subjective ways of knowing. This mode of inquiry represents women and the feminine as inferior, if not invisible, and obscures the gendered politics of knowledge. In other words, the science, the technology, and the results may all disadvantage women by reinforcing social power relations. Even the language of science, down to the cellular level, is often gendered in such a way that female biological processes are characterized as *passive* and male as *active* (Martin 2001; Angier 2000). In a different field, psychologists long made assumptions that a lack of interest in mothering, or an interest in homosexual activity, to use another example, was "abnormal" for women. As early as 1968, feminist scholar Naomi Weisstein identified the language and bias of psychological diagnoses and urged psychologists to treat women as *individuals* rather than as a group expected to adhere to widespread social beliefs about gender (Weisstein 1968). These were among the early feminist interventions into the very questions, foundations, and language of scientific inquiry. Feminist scientists seek to advance knowledge for its own sake, but their work is grounded in the theoretical frameworks of feminist philosophy and the history of science, which acknowledge that science has historically been used, and may still be used today, to justify social and political beliefs and goals.

Feminist critique has also brought new questions regarding scientific ethics into the debate. The core of the feminist approach is to point out that science is situated in, not separate from, a specific social–historical–political context. Therefore, science involves not only objective data but subjective interpretations, which in turn involve questions of morality or ethics. Early scientific pursuits saw nature (including the human body) as passive and something to be controlled by humans, a social value or belief that still guides some scientific research. How we define the essence of human nature or bodies is a value judgment, influenced by, for example, religious or political views; this is why politics and religion are so involved in a

variety of scientific debates in modern America, such as cloning, abortion, stem cell research, or DNA testing. In the natural and physical sciences, such as the fields of ecology, environmental science, climate change, animal sciences, and evolution, politics and religion play a large part in influencing the interests, the questions, the funding, and the outcome of scientific research.

Feminism has also had a voice in questions of medical ethics, both in research and in healthcare. Medical ethics involves questions of equal access, patient's rights, and the doctor's pledge to "do no harm." Although these principles apply to a broad range of healthcare issues that affect women, feminists have focused primarily on reproductive issues as healthcare and social policy issues. From contraception, abortion, and sterilization, to infertility, pregnancy, surrogacy, and childbirth practices, to menopause and hormone treatments, feminism has brought women's health issues to the forefront and pointed out that science and medicine are not value-neutral in the development of new technologies and practices. For example, why has modern science not yet developed an oral contraceptive for men? Or, why are there so many Caesarean sections in the United States compared to other developed nations, and why do many health-insurance plans refuse to cover alternatives such as home births? The issues are numerous, and the debates and implications complex, but feminists emphasize how social and political views, biases, and beliefs influence both the research and practice of women's health.

Feminists are among those who question whether the goal of science is knowledge for its own sake, or whether manipulation of nature, or specific religious or political goals, are factors as well. Feminists must also be aware, however, of their own political purposes in these debates. While feminists have been accused of bringing politics into science, feminist scientists and scholars point out that *sexism* is not an objective scientific method. Science is rarely *value-neutral* (for example, scientific research agendas are often set by financial, political, or military goals), and is never objective if gender or racial bias informs the very role of the scientist and the questions asked. As an alternative, more subjective, epistemology, feminism acknowledges that all individual scientists bring background assumptions, biases, and specific experiences, goals, and priorities to their work, even unconsciously. Far from politicizing science with a new set of assumptions and agendas (as some critics charge), feminism only demands that scientific research live up to its *own claims* of objectivity, free from bias and political influence, supported by evidence, and in the name of knowledge for its own sake.

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Science and Technology Education for Girls

One reason for the interest in the question of sex-based difference in science and math test scores is that, in nearly every other educational outcome, girls outperform boys. Girls do better on reading and writing assessments, get better classroom grades, and are more likely to graduate from high school, and, since the early 1980s, women receive more undergraduate college degrees than men. Undoubtedly, some of this is the result of the feminist movement of the 1970s and 1980s taking up the educational inequality of girls as a social and political issue. Feminists began to look to the classroom (among other places) and found evidence of gender discrimination, and the resulting low self-esteem and missed opportunities, against the youngest female members of society, finding not only that boys dominated classroom discussions and that teachers had lower expectations for girls' performance,

but that even the materials taught—from the literature chosen to history textbooks—focused on males and their interests, or were often absent of females. The raising of that consciousness led to social programs and policy changes to address equality in the classroom and the career paths of young women.

The whole idea of science education is a twentieth-century development. Attempts to standardize science curricula at the high school level began in the 1890s, with recommendations for a breadth of knowledge to include physics, astronomy, chemistry, and natural history. Before the 1920s, however, science education for young children focused primarily on nature study, and was certainly not formal or systematic. Domestic science, or home economics, became a standard part of the curriculum for girls beginning in the first half of the twentieth century, as the goal of early education was to prepare girls for future roles as wives and mothers, whereas boys were tracked into vocational or technical courses (according to class expectations as well). But the modern science curriculum for elementary and secondary students is a product of the Cold War, beginning in the 1950s, when the government investment in science and technology education meant that boys and girls would be offered the same science curriculum through the public schools. To fit with new national military and industrial commitments, the “hard” sciences of physics and chemistry replaced an earlier emphasis on nature study, even at the elementary level; the “science experiment” and “science fair” became ubiquitous features of modern American science education (Tolley 2003).

Beginning in the 1970s, the U.S. Congress passed a series of acts to ensure educational equity in everything from sports opportunities to vocational training to funding for science and math education. While girls’ *access* to educational opportunities expanded throughout the 1970s and 1980s, and social programs such as the Ms. Foundation’s “Take Our Daughters to Work Day” (established in 1993) showed an effort to expose girls to a broader range of career possibilities, in 1992 the American Association of University Women (AAUW) published its groundbreaking report, *How Schools Shortchange Girls*, exposing the sometimes blatant but often subtle ways in which schools and teachers disadvantage girls in the classroom and ultimately discourage them from “nontraditional” pursuits, including math and science (AAUW 1992; see also AAUW 2000 and AAUW 2004). This attention resulted in a vast new literature on gender and education and, by the late 1990s, a pendulum swing to scholars, experts, and parents arguing that *boys* are now shortchanged when their needs and learning styles are ignored in the new girl-friendly school environment (Tyre 2008). These studies argue that neglecting the particular physical and emotional needs of boys in the classroom has led to a generation of boys diagnosed with (and prescribed medication for) attention deficit disorder, an epidemic of violence in the schools, and lower graduation rates of and college attendance.

If girls have greater advantages in the elementary and high school classroom, and perform well in science and math courses in particular, the question is not only one of lower SAT scores, but of fewer girls continuing on in science career paths. What other factors explain their continued underrepresentation in math and science careers? There are two main questions to address. First, are teachers and parents still treating girls differently, especially in regard to science and math ability? Second, what do girls think about women and science?

From elementary through high school, some fear that girls are getting a different education, both quantitatively and qualitatively, than boys. Much research has been conducted over the past 20 to 30 years on classroom dynamics, and on the way teachers (and parents) treat girls differently and track them according to gender stereotypes, from boys receiving more attention (positive and negative) in the classroom, to teachers expecting less from girls, to methodologies (tests, etc.) that favor the ways boys learn over the ways girls learn, to the lack of female role models in the classroom and in textbooks. Numerous studies have shown that deep-rooted ideas about gender continue to filter into teacher interactions with girls. One study conducted over the course of 25 years “found that girls were eight times less likely to call out comments, but when they did were reminded to raise their hands. In contrast, teachers responded to the typically rowdier and more assertive behavior of boys. Thus highly intelligent young girls often give up their own assertiveness and risk-taking behavior fulfilling social virtues of selflessness and cooperation” (Etzkowitz, Kemelgor, and Uzzi 2000, 39).

When it comes to the role of education and educational policy, the debate over sex-based differences in ability is less important than the belief that everyone deserves equal access and equal education, and the belief that any subject can be taught. Even if there are no significant biological or innate ability differences between how the sexes learn, are there “taste differences” that account for fewer women developing an interest in science in the first place? (This point was made by Harvard president Lawrence Summers in his controversial 2005 remarks explaining why there are fewer women in high-level science positions.) The observation has been made by some that women, in general, are more interested in people and in relationships than in solitary lab work, for example. Regardless of whether this is due to biology or to social conditioning (or whether it is even true for all women), one must ask whether this is an accurate understanding of what scientists do. It may, in fact, explain the higher numbers of women in “helping” professions such as medicine (and certain subspecialties within medicine), veterinary medicine, or psychology, but it does not explain the variety of skills and activities that engage scientists across disciplines in relation both to people (the solitary lab scientist is something of a myth, as researchers must coordinate teams of students and colleagues) and to the subjects

of their research (e.g., the cancer researcher engaged in lab work, or the computer scientist writing educational software, are still involved in a quest to “help” people).

One thing is certain: The continued *perception* at least (if not evidence) that science, technology, engineering, and math are “male” fields or that boys have more natural aptitude in these areas has an influence on whether girls choose these subjects of study or move on to pursue careers, and on how women scientists are ultimately treated in the lab, the field, and in academia. In other words, the debate itself influences how girls and young women perceive themselves, as well as how others perceive them, regardless of their educations and achievements. Researchers at the University of British Columbia examined the issue of “stereotype threat,” or the effect of perceived truths about members of a group, in relation to women’s science and math achievement. Their studies found that “women who read of genetic causes of sex differences performed worse on math tests than those who read of experiential causes” (Dar-Nimrod and Heine 2006).

Female students may also fear being labeled a “smart girl.” This has become such a concern that the National Science Foundation launched a website/program called SmartGirl (<http://www.smartgirl.org>) for girls aged 11 to 17 that, while not specific to science education, provides a significant amount of information on career choices, including an extensive list of links related to STEM careers. Another program, NerdGirls (<http://www.nerdgirls.org>), was started by a professor at Tufts University for her female engineering students, and the organization’s mission is “to encourage other girls to change their world through Science, Technology, Engineering and Math, while embracing their feminine power.” They also seek “to dispel the myths and stereotypes about these fields and the women who choose to enter them.” Girls, Inc. created a nationally implemented program called Operation SMART (Science, Math and Relevant Technology; <http://www.girlsinc.org/about/programs/operation-smart.html>), which advises parents and teachers to “*Assume* girls are interested in math, science and technology,” and support and encourage them accordingly.

One of the most famous ongoing experiments has been the study of stereotypes and images in the “Draw-A-Scientist Test” (DAST). Begun in the early 1980s, the test has been used in recent years internationally to look at children, college students, *and* teachers, at different school levels and with student populations of different ethnicities, as well as the two sexes (Steinke et al. 2007). An analysis of DAST shows, among other things, that the older the student (from elementary up through middle and then high school), the *more likely* he or she is to portray a scientist as male (and white). For example, a 1999 study showed that students in kindergarten through second grade drew male scientists 58% of the time, compared to up to 75% of the time among students in sixth through eighth grade (Hall 2007, 25). Views about scientific ability and who can be a scientist may also present at home. New research shows that the attitudes of parents—especially

fathers—are important indicators for determining a girl's interest and success in math. Fathers must encourage their daughters, show interest in their math and science studies, and *expect* girls to be good at math, as paternal confidence and attitudes figure significantly into a girl's view of her own abilities and potential (Univ. of Michigan 2007). It is, of course, not surprising that the issues and messages of the culture at large are magnified in the home, and that the attitudes of parents are some of the most influential on young girls.

Still, increasing numbers of girls are taking higher-level math and science in high school. According to the National Assessment of Educational Progress, in 2005, some 42% of twelfth-grade girls had taken both biology and chemistry, and 29% had taken biology, chemistry, and physics, slight jumps from just a few years earlier (Hall 2007, 20). Still, their numbers are often not high enough in individual classes to counter the idea of math and science as male endeavors, and girls who do well are seen as exceptional and different, making it hard for girls to think beyond high school to consider science careers. In a perpetual negative cycle, then, the fewer the young women who enter into science careers, the less likely students will be to encounter the female role models and science teachers needed to inspire the next generation of girls. Girls who attend all-girl high schools choose science, math, and engineering majors in college in higher numbers (Hall 2007, 33). If girls in other contexts are discouraged from or avoid difficult science classes, they simply will not be *prepared* to take college-level science courses, regardless of interest or ability, another factor against deciding on a science major. In other words, early intervention is necessary—thus the focus on science education and organizations for girls in the middle and high school years.

In response to these issues and concerns, numerous programs have been established to encourage girls in science and technology majors and careers. These programs target students, parents, and teachers, and are sponsored by educational institutions, corporations, nonprofits, and government. Efforts range from education, to mentoring programs, to special projects and clubs, to financial assistance in the form of scholarships and grants for female science majors. Education requires not only increasing the numbers and preparedness of girls taking advanced math and science courses, but also educating girls as to the range of career possibilities in science and technology. A National Academy of Sciences website on girls and science (<http://www.iwaswondering.org>) provides guidelines to teachers, including awareness about social stereotypes, types of and reasons for praise of boys and girls in the classroom, and countering negative perceptions about science as a career path for women. A wealth of literature and programs exist offering advice to teachers on how to create a gender-neutral classroom. Some important strategies for teachers collected from various programs include encouraging creativity and innovation, creating opportunities for meaningful collaborative work among peers and

with adults, making an effort to represent women in the sciences (through classroom materials, images, classroom visitors, or field trips), and praising students (male and female) for their efforts and process, not just for following the rules.

Resources for Girls, Their Parents, and Teachers

“Discover Engineering,” National Engineers Week Foundation. <http://www.discoverengineering.org>.

“Earth Science,” For Kids Only, NASA. <http://kids.earth.nasa.gov>.

“Engineer Girl,” National Academy of Engineering, National Academy of Sciences. <http://www.engineergirl.org>.

“Expanding Your Horizons Network: Motivating Young Women in Science + Mathematics.” <http://www.expandingyourhorizons.org>.

“Science,” KidSites.com. <http://www.kidsites.com/sites-edu/science.htm>.

“Science News for Kids,” Society for Science & the Public. <http://www.sciencenewsforkids.org>.

“Sci4Kids,” USDA Agricultural Research Service. <http://www.ars.usda.gov/is/kids>.

“TryEngineering.” <http://www.tryengineering.org>.

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Women and Science in College and Graduate School

The educational issues and challenges facing girls and women in the sciences continue beyond high school. Women's formal science education at the college level dates to the nineteenth century and corresponds with women's access to higher education in general, whether through the women's colleges or through co-educational institutions. Co-educational colleges in the United States originated in the Midwest when Oberlin College in 1837 began admitting women and African Americans. The land-grant institutions, which were often co-educational, were established by the Morrill Act of 1862 and focused on the agricultural sciences, with an emphasis on chemistry, nutrition and food sciences, animal sciences, and botany and horticulture. The women's colleges founded in the late nineteenth century also became centers of scientific education for women, both undergraduate and graduate. Among women who went on to earn doctorates in the sciences, the majority came from undergraduate programs at women's colleges; the top five colleges conferring bachelor's degrees in science to women before 1920 were all Eastern single-sex institutions (Mount Holyoke, Barnard, Smith, Vassar, and Wellesley) (Rossiter 1982, 144). For doctorates, however, the University of Chicago and Columbia University in New York awarded the highest number of science Ph.D.s to women through the 1930s (Rossiter 1982, 170–171).

Efforts to encourage more women to pursue careers in the sciences, including funding and mentorship programs, brought a steady increase in the number of women science majors after the 1970s. In 2006, women received slightly more than 50% of all bachelor's degrees in the sciences and engineering (NSF Table C-14). There is great variation by specific fields, with women earning the majority of degrees in psychology, social sciences, and the biological sciences, but smaller percentages of degrees in physical sciences and engineering. The "leaky pipeline," however, means that the number of women science candidates drops at critical junctures along the educational and career path, so that while women earn 50% of science bachelor's degrees only 38.4% of STEM doctorates go to women (NSF Table F-2). The "leak" in the pipeline between undergraduate and graduate school completion may be explained in part by decisions about family life made during a woman's late twenties and early thirties, coinciding with the years dedicated to a graduate program. A marriage, a spouse's employment options, and whether and when to have children all affect not only the timing of completion

of a program, but funding, grants, mentoring, and research opportunities. Considering the significance of work/life issues to women during these years, one scholar has concluded that “The human price for the Ph.D. is higher for women than for men, and the rewards are often lower” (Etzkowitz, Kemelgor, and Uzzi 2000, 95).

While taking into account that many capable or interested female students decide to apply their talents elsewhere than the sciences, and that not all undergraduate science majors plan to continue on for advanced degrees in science fields, a woman’s undergraduate educational experience will also influence her decision whether to continue on in pursuit of a STEM doctorate and career. If women are discouraged in difficult courses, they may assume that they do not have enough ability to succeed in math and science, and may choose not to pursue science and math majors. A 2003 study of students in difficult pre-med chemistry and calculus courses at Columbia University found that whether a student has a view of success in STEM courses as a matter of innate ability (or a “gift”) or has a belief that hard work and individual effort will result in success determines female university students’ “vulnerability” to being discouraged away from science. Among students who believed that success in the course was determined by innate ability, male students earned higher grades; among students who considered intellectual skills to be acquired or developed, female students earned higher grades and were more likely to continue with the course than those who believed they possessed a gift (Dweck 2007, 49–50; see also Dar-Nimrod and Heine 2006). Success and good grades in courses like these (required courses for science and math majors) across the nation are a strong indicator of continued pursuit of a science major and continuing on to a scientific career.

The status hierarchy of science fields thus begins in college, where fields deemed “easier” happen to be those with more women (biology or psychology), and the more “difficult” fields, which are also those presumed to require more math skills (such as physics, chemistry, and engineering), are dominated by men. Few female undergraduates will have many female faculty members for role models and, while some women say they do not expect to have many female faculty when deciding to major in science, it may still have an effect on their future choices in the field. A 2005 study of colleges in the late 1990s found that “women who had a female instructor in their first course in geology or mathematics and statistics were more likely to take additional courses in those subjects. In physics and biology, however, women were more likely to take additional courses if their first instructor was male” (Hall 2007, 118). Of course, the mere presence of female professors does not mean that they will be mentors or develop positive relationships with female students, but they are role models nonetheless.

The classroom experiences of women in the sciences are also an important factor in deciding to pursue STEM majors and careers. College science classes

are notorious as highly competitive “weeding-out” systems that, some argue, strike particularly hard at women. While attempting to discourage the less serious students may seem meritocratic (that is, with everyone having the same opportunity to succeed or fail), it may in fact serve a professional gatekeeping function by operating to cultivate a particular type or group of students preferred in the profession (Etzkowitz, Kemelgor, and Uzzi 2000). Highly competitive classes reward individual achievement rather than collaboration; have an extremely rapid pace of coursework; have a pace and format of testing that rewards certain learning styles, assertiveness, and lack of mentoring on the part of faculty; have a lack of personal contact between faculty and student; and, in some cases, allow outright exclusion of women from study groups or other opportunities. When female students do ask for help or express doubts about their abilities, they may be seen by male faculty or fellow students as overly emotional or showing weakness, or even as sexually available—all of which makes it harder to get help and thus increases women’s isolation. Feminist critics argue that these experiences in the weed-out process create a particularly male culture of individuals “winning” at all costs, and deny other modes of socialization and learning. For many female students, it is, if nothing else, contrary to the encouragement, mentoring, and collaboration they may have experienced in their high school science programs.

But is this a universal experience for women in college? The women who do succeed in college science courses under these conditions report positive experiences that led them to further pursue science at the graduate level. Of course, there are variations in childhood socialization, individual interests, and personality styles that account for the career choice and success of any particular individual. The importance of female role models and of supportive and communicative mentors (whether male or female) is often cited as one of the most important factors in the success of women in science education, at both the undergraduate and graduate levels. The experience of women as science and engineering students in college varies, depending not only on the program and faculty, but on the college itself. For example, in assessing the difference between women’s colleges (which trained many of the early-twentieth-century female scientists) and technical colleges, some argue that women’s colleges give female students a chance to do their personal and intellectual best without either explicit or subtle discrimination, and without feeling that they are in a minority in their field. Of course, this can be a protective environment that is not realistic in preparing women for graduate school or their later employment situations. While many young women may be deterred from pursuing science majors for various reasons, many others pursue what interests them most or, in some cases, are specifically challenged by the idea that they can be one of the few or exceptional women to enter into a field.

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Jobs for Women Scientists: Academia

The academic career track in all disciplines is organized along an advancement "ladder" leading to and through the stages of tenure. In the sciences, once a Ph.D. is received, the postdoctoral fellowship or position (or "postdoc") is a critical career step during which one gains laboratory or research experience with mentors in the discipline; a scientist may then be hired as an *assistant professor* (an untenured position), then, once tenure is received, advance to *associate professor*, and then *full professor* (or simply "professor"), which is the highest academic

teaching rank. Science faculty may also be appointed to high-level administrative positions as *department chairs*, *provosts*, or *deans* of programs within a university, or campus-wide administrators, including university and college *presidents*. *Instructors* or *adjunct faculty* are often temporary, affiliated, or part-time appointments, with no promise of tenure.

Although many women scientists work throughout government and private industry, much emphasis and analysis has focused on the research-intensive academic career track as the assumed path for women in the sciences. Perhaps because scientists in academia are more organized according to separate disciplines—and because gender issues are more often discussed in a university setting—there have been numerous

studies and statistical tracking of the status of women scientists in academia. By 2006, however, only about 19% of women scientists and engineers were employed in universities or four-year colleges, and another 6% worked in other educational institutions, teaching in secondary schools or two-year colleges that do not emphasize (or allow time for) research and publication; this is compared to almost 50% of women scientists and engineers employed in business and industry (NSF Table H-19).

Before 1940, the overwhelming majority (as many as three-quarters) of professionally trained women scientists worked in colleges or universities, many in the women's colleges or in non-tenure-track lecturing and research or laboratory assistant positions (Rossiter 1982, 160). After World War II, access to higher education and professional employment opportunities became more restrictive for women, so that by 1958, women made up only 10% of scientists employed in educational institutions (Rossiter 1995, 107). It was not until after the 1970s that women's numbers in academia began to rise again, but by then, technological advances in computers, aerospace, medicine and pharmaceuticals, and other fields led to the expansion of opportunities in government and private industry, so that academic science was not the only option.

In the nineteenth century, both men and women might begin teaching without acquiring or before completing their own advanced academic degrees; others



Astronomer Cecilia Payne-Gaposchkin discovered that stars, including the Sun, are composed mainly of hydrogen. (Bettmann/Corbis)

found permanent positions as research or lab assistants. The first female college professors were employed at women's colleges, or at larger co-educational institutions teaching "women's" subjects, assigned to the home economics department rather than the biology or chemistry departments, for example. Heavy teaching loads and administrative responsibilities prevented many women from achieving the research and publication records necessary for tenure or wider professional recognition; others found that tenure-track promotions eluded them regardless of their teaching and research accomplishments. Chemist Ellen Swallow Richards was the first female faculty member at the Massachusetts Institute of Technology (MIT) in the 1870s and was internationally recognized for her work; still, she remained at the untenured level of "instructor" for her entire 30-year career. There were even cases of women's names being left off faculty rosters in order to avoid controversy with boards of trustees or alumni who might object to female faculty in certain subjects, although in the early 1900s most colleges and universities began to adopt more objective hiring and tenure guidelines that limited the influence of donors or alumni. Astronomer **Cecilia Payne Gaposchkin** worked at the Harvard Observatory in the 1910s and 1920s, where she had no official title and her lectures were not listed in the catalogue. She later described how funding for her position at the observatory was identified as an "equipment" expense and how she was not accepted or even acknowledged in the Harvard community at large (Rossiter 1982, 211).

In 1921, a special committee of the American Association of University Professors conducted one of the earliest surveys on the status of women in academia. The committee included several prominent women scientists at the time, including Bryn Mawr geologist **Florence Bascom**, and found that of 100 co-educational schools surveyed, 27 had no women faculty at all, in any field (not just science) and at any level. Of those with women on the faculty, women made up 23.5% of instructors, but only 4% of full professors (Rossiter 1982, 163). Of the top six colleges employing women scientists, the largest number were, not surprisingly, concentrated at the women's colleges: Wellesley, Vassar, and Mount Holyoke had the highest numbers of female science faculty (Rossiter 1982, 182). In 1938, only three women were department chairs or deans of science schools or departments, and all three of these were in departments of nutrition or home economics: **Lydia Roberts** at the University of Chicago, **Flora Rose** at Cornell University, and **Abby Marlatt** at the University of Wisconsin (Rossiter 1982, 182).

After a post-World War II retrenchment in academic opportunities for professional women, it was not until the civil rights legislation of the 1960s and then the women's movement of the 1970s that women regained access to higher education and employment, especially in "nontraditional" fields, including STEM fields. The first problem for women in academic employment is getting hired,

Title IX and Women's Education

The civil rights legislation passed by the U.S. Congress in the early 1960s is recognized for ushering in a new era of racial equality, but the legislation also had an enormous impact on women's educational and employment opportunities. The Equal Pay Act of 1963 was followed by Title VII of the 1964 Civil Rights Act, which "prohibits employment discrimination based on race, color, religion, sex, or national origin," and created the Equal Employment Opportunity Commission (EEOC) as a federal-level agency to address such issues. Title IX (part of the later 1972 Education Amendments), recognizing the need to open pathways to employment, went further in forbidding discrimination in educational institutions. The main passage of the law reads, "No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance." Although a simple statement, the effect of Title IX had a wider impact, not only on educational admissions and hiring but also on funding for women's athletics, ushering in a new era of training opportunities for professional female athletes. In 2002, Title IX was renamed the Patsy Mink Equal Opportunity in Education Act, after the late Congresswoman from Hawaii who authored the Act.

especially in periods or cycles when there are fewer jobs than applicants. In 2003, for example, there were 1,200 new physics Ph.D.s, but only 679 new faculty positions at all colleges combined, including part-time and community colleges, which are nonresearch positions (Hall 2007, 160). Of course, many of these new physics graduates would undoubtedly go into industry or government positions, but in other fields or disciplines, there may be even fewer opportunities outside of academia. Significant advances have been made since the 1970s in eliminating (or minimizing) gender discrimination in hiring, and new studies show that new female Ph.D.s on the job market, although underrepresented in some fields, face a level playing field when applying for jobs ("Women Faring Well" 2009).

While women are not necessarily disadvantaged in the tenure-track hiring process, there is still what is referred to as a "leaky pipeline," with fewer women present the higher up the advancement ladder one goes, and their numbers drastically reduced in some fields on the way from graduate student to assistant professor to tenure. Despite decades of women's advancement in individual disciplines, at the highest academic levels (full professors and department heads) there are still few women compared to the numbers of female Ph.D. recipients and junior faculty members. A 2000 report found that a woman chaired only 4.2% of the more than 500 STEM departments surveyed (Hall 2007, 177). As tenure-track or full

professor status is required for consideration as chairs, deans, and provosts, not to mention university presidents, there are ultimately fewer women from which to choose for these positions.

Again, the problem of the “leaky pipeline” is institutional rather than individual, as several women scientists have served as university presidents, and in the early twenty-first century, several of the most prestigious universities named scientists as their first female presidents: Chemical engineer **Alice P. Gast** (Lehigh), neurobiologist **Susan Hockfield** (MIT), physicist **Shirley Ann Jackson** (Rensselaer Polytechnic), molecular biologist **Shirley Tilghman** (Princeton University), and astronomer **France Cordova** (Purdue University) all currently head these universities. The achievements of these (and many other) high-profile women scientists, however, may obscure the larger problem of the low representation of women in STEM fields; ironically, some of the lowest representation among faculty overall is in the very disciplines in which these individual women were trained (physics and astronomy, for example).

The academic tenure system also presents a unique work/life balance problem. It would seem that academia might be more flexible than other types of employment, as many people assume that professors’ primary role is teaching courses for only a few hours per week, with summers off. In the sciences, however, the demands of laboratory work and management can require seven-day work weeks, and the pressure and expectations of the tenure clock begin with the first postdoctoral position. For women who want to have and raise children, the time required in the early years of one’s career working toward tenure (which requires several years of postdoctoral research, building relationships with mentors, receiving accolades for teaching, and publishing) coincides with the female biological clock of the twenties and early thirties. For women who do marry or have children during this process, family considerations impact decisions not only about the tenure clock but about geographical mobility and partner hires. Academic couples must consider whether one partner will be able to accept a prestigious appointment if the other cannot easily relocate or find a comparable position. Academic departments may consider male and female applicants on their individual merits, but questions of family obligations and spousal or partner hires may be difficult negotiations if both partners are academics or work in the same field. Family considerations may impact women’s careers, so they advance more slowly, participate in fewer well-funded projects, take longer to tenure or accept less prestigious positions, and ultimately earn less income over the long term.

A final problem for women scientists in academia is discrimination on the job itself. One high-profile study of gender equity revealed that, as of 1996, there were only 22 female professors at MIT, compared to 252 male faculty. The study also revealed disparities between male and female faculty members in terms of salary,

lab funding, support, and even research space (Rosser 2004). This was a study done by and within just one university, a major science and technology institution, and so it raised questions about the status of women faculty at other colleges and universities. Unlike in the humanities, much funding for scientific research comes from outside the university system, from government or private sources, but here, too, there has been shown a disadvantage for projects led by women. A 2005 study of grant applications and awards from the major federal sources of research funding—the National Institutes of Health (NIH), National Science Foundation (NSF), and the USDA—found that women overall were less likely to receive funding for their projects and were less likely to reapply for the same grants; the report authors suggested that these were only preliminary findings and called for better tracking by the funding agencies themselves (Hosek et al. 2005).

In 2005, Harvard University president Lawrence Summers proposed several possible reasons, both biological and social, to explain the lack of women in high-level academic science positions (Summers 2005). In response to the controversy created by Summers's remarks, Harvard established a Task Force on Women Faculty and Women in Science and Engineering with the goal of analyzing the "pipeline" problem in the academic career path, and making recommendations at the institutional level in regard to "recruitment, support, and advancement of outstanding women faculty in the University." Some scholars have questioned affirmative action for women, which is most often clearly practiced in academia, arguing that the underrepresentation of women does not mean that there should be specific efforts to increase their representation, potentially to the disadvantage of qualified male candidates (Kimura 2007, 44). Others questioned the attacks made on Summers directly (who suggested that there may be innate as well as social reasons explaining women's lack of interest in or preparation for STEM careers), arguing that his remarks should serve merely to begin a system-wide conversation regarding the goals of university science departments, but that more focus should be on early intervention and education, such as encouraging young women to enroll in more difficult science courses in high school and college.

Finally, the academic work environment and women's individual career success in the sciences is impacted by the presence of female faculty as mentors and advisors to younger women in college and graduate school. Some faculty take on this special role with pride, but it also creates certain social pressures, as women faculty members may be *expected* to make extra time for mentoring students in a way that male professors are not or do not (Etzkowitz, Kemelgor, and Uzzi 2000, 149). This creates a paradox, as many female faculty members report that they had critical support from their own mentors, and so they feel they owe something to the next generation, especially in encouraging female students in science careers. But they must prioritize their own careers and productivity in order to

compete and move up the ladder. If they sacrifice their own advancement schedule, there will continue to be fewer women as role models at the highest levels. Female faculty members also need time to seek out support from other women in science, finding peers beyond their own departments and institutions, where they are likely to be in a minority within any given field. Professional scientific organizations, and women's committees within those organizations, can be essential resources for career, legal, and discipline-specific assistance and guidance.

While tenured academic positions provide the stability and institutional framework and resources necessary for conducting research (including laboratory space, graduate students, and postdocs), faced with contingent, part-time, or nonresearch positions, struggles with funding and promotion, or just general isolation, some women scientists plan to pursue academic jobs, but decide to leave and practice science elsewhere. Others discover early on that they are not particularly interested in academia, finding more stability and (simultaneously) more flexibility, and often more lucrative positions, in nonacademic employment. As the twenty-first century begins, more women faculty are needed at every level to serve as role models for the next generation of female scientists.

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Jobs for Women Scientists: Government

According to a 2006 report from the National Science Foundation, 10.4% of all women employed in science- and engineering-related occupations worked in federal, state, or local government, only slightly less than the number employed in academia (NSF Table H-19). Although more attention is paid to job outlooks and conditions for women scientists, students, and faculty members in academia, the connection between government and science, especially beginning in the mid-twentieth century, has meant not only more funding for academic research, but more government-based research as well. A few notable women were employed by the U.S. government in the late nineteenth century, and these were clustered in a few agencies, in particular the USDA and USGS. In 1896, **Florence Bascom** was the first female scientist hired at the USGS; in 1910, **Eloise Gerry** began working at the U.S. Forest Service; and in 1916, Ida Bengtson was the first woman scientist to join the U.S. Public Health Service (later known as the National Institutes of Health) (Rossiter 1982, 219). World War I and the era of Progressive reform saw the creation of numerous federal bureaucracies and agencies.

From the 1910s through the 1930s, many women with science and math backgrounds filled low-level, underpaid, “women’s” jobs as clerks, stenographers, indexers, science writers, and laboratory assistants, but few were able to advance to managerial or project director positions. Progressive reform efforts also saw increases in the numbers of women employed in public health, child welfare, psychology, and other social work in state and local government offices and institutions, while wildlife biologists, botanists, and archaeologists worked for government field stations and publicly funded museums.

The USDA (which encompassed numerous departments or bureaus related to issues of food and nutrition, agriculture, bacteriology, chemistry, and home economics, among others), in particular, has always been a significant employer of women, as scientists but also in clerical and nonscientific positions. A 1925 report by the new federal Women’s Bureau found that a full two-thirds of women scientists employed by the federal government worked at the USDA, most as botanists or chemists (Rossiter 1982, 227). Within the USDA, women were concentrated in food, nutrition, and plant sciences, or in home economics, and many women scientists achieved early positions of prominence. **Flora Patterson** supervised the herbarium in the Bureau of Plant Industry for nearly 30 years at the turn of the twentieth century. Chemist **Mary Pennington** spent a decade as chief of the food research laboratory after it was established in 1908. And chemist **Louise Stanley** was for many years the highest-paid and highest-ranking women scientist in the federal government as head of the USDA’s Bureau of Home Economics, a position she held for more than 25 years, from 1923 to 1950. The USDA remains a significant employer of women, reporting in 2007 that women make up 44% of their total permanent workforce (USDA Newsroom, 2007).

The immediate postwar period saw a retrenchment of positions for women, however, as returning male veterans filled available jobs, a pattern repeated in the World War II era. The labor shortage brought on by World War II, combined with wartime technical needs, meant more employment opportunities for female scientists in government and industry during the war as nuclear physicists, chemists, meteorologists, and engineers. While some earlier female-dominated agencies, such as agriculture and nutrition, were significantly decreased, new areas of growth brought large numbers of microbiologists, mathematicians, engineers, and toxicologists into government work; the Department of Defense became the largest government employer of women after World War II (Rossiter 1995, 277–279). After the war, however, there was a precipitous drop in the numbers of women scientists and engineers in government agencies, numbers that would not be recovered again until the 1970s, when the government was forced to change due to its own antidiscrimination civil rights legislation.

Throughout the twentieth century, government agencies, unlike academia or private industry, seem to have been less likely to discriminate in hiring and

advancement based on gender and less likely to be concerned about a woman's marital status. Nor did the government follow anti-nepotism rules that kept many women scientists of the early twentieth century out of academic appointments if they were married to fellow scientists. High-profile scientist couples who built careers outside of academia in the mid-twentieth century included crystallographers Jerome and **Isabella Karle**, who spent more than six decades at the Naval Research Laboratory, and physicists Maurice and **Gertrude Goldhaber**, who left academia to work at Brookhaven National Laboratory for more than 30 years, also consulting at Argonne and Los Alamos laboratories.

The 1950s brought new national commitments and international competition in the space race and the nuclear arms race. These political and military concerns ushered in a "golden age" of government funding for science and technology innovation, and the greater numbers of Ph.D.s awarded after the 1960s meant that academia could not provide employment for all trained scientists, although supply and demand varied by field. New science and technology research programs within all four branches of the U.S. military grew exponentially in the post-World War II and Cold War eras. One of the newest and most noteworthy federal programs of the era was the new National Aeronautics and Space Administration (NASA). Created in 1958, it took 25 years, until 1983, for NASA to allow women into the astronaut program. Since the 1980s, women scientists and engineers at NASA have distinguished themselves as astronauts (in 2009, NASA sent its fiftieth female astronaut, Karen Nyberg, into space), as well as on the ground as aerospace engineers, computer scientists, physicists, chemists, and medical and biological researchers.

Along with the space program, the federal government (under the auspices of the military, or through agencies such as the USGS) has sponsored geological and oceanographic expeditions, sending the first women scientists to the Arctic, to Antarctica, under the sea, and to other points around the globe. The development of the computer in the second half of the twentieth century also ushered in a new era of opportunities for women scientists and engineers. Many women worked for government agencies responsible for the early stages of computer development, and the first programming languages, software programs, and Internet applications were developed for government and military use.

Women scientists working within the government faced different opportunities and different paths, but some of the same issues as women in industry or academia. Gender bias and work/life balance issues affect professional women across disciplines and sectors of employment, but differences in flexibility, work schedules, and even pay have led many women scientists to see advantages in nonacademic positions. Industry and government salaries are potentially higher than those in academia, even without a doctorate, such as in computer sciences and engineering. Scientists working in government jobs do not have the same tenure

and publication pressures required for advancement in academia, and government agencies often have firmer, more objective promotion and pay policies that make subtle bias against women harder to justify. But the “glass ceiling,” an invisible barrier to women’s advancement to the highest levels, still exists. A 2005 Equal Employment Opportunity Commission (EEOC) report on six national energy and weapons laboratories found that women are still disadvantaged when it comes to pay and rates of promotion within government positions. Among their specific findings related to gender were that women consistently earned 2% to 4% less than men (and minorities earned less than whites), and the report responded to concerns about the underrepresentation of women in certain jobs and opportunities for women to advance their government careers (U.S. GAO 2005). Likewise, a 2002 study of Argonne National Laboratory in Chicago found that female Ph.D.s were more likely to start at a lower pay level, while men were hired in at higher levels, thus putting women on a slower promotion track (Hall 2007, 190). Combined with time off or part-time status to raise families, this may potentially put women years behind their male colleagues who entered the field at the same time. Finally, concerns about underrepresentation in certain fields or agencies means that if few women are employed in a particular lab or facility, it may be difficult to find mentors or networks.

Still, it is widely believed that corporations and government agencies are more likely to have family-friendly and flexible work policies, compared to academia, including more set work hours (a 40-hour week compared to the sometimes around-the-clock expectations of university labs). Scientists employed in government labs are also able to focus solely on research, without teaching and other student-related or administrative duties demanded in academia. The possible downside of government employment, compared to a university setting, is that someone else (besides the scientist) often sets the research agenda, either according to government policy directives or corporate interests based on profit. Scientists working in government (and industry) in collaboration, where a larger policy (or profit) motive determines the course of research, do not tend to receive the individual recognition that professors do, who must be concerned with the originality of their work for gains of tenure, awards, and prizes.

Still, by the end of the twentieth century, many women had achieved “firsts” in the highest-level national government appointments. Aeronautics engineer **Sheila Widnall** served as Secretary of the U.S. Air Force (1993–1997), the first woman to lead a branch of the military; pediatrician **Antonia Novello** was the first female U.S. Surgeon General (1990–1993); cardiologist **Bernadine Healy** was the first woman to head the National Institutes of Health (1991–1993); and economist **Alice Rivlin** was the first director of the Congressional Budget Office (1993–1996). In 2009 alone, two women were named as heads of important federal scientific

agencies: marine ecologist **Jane Lubchenco** as head of the National Oceanic and Atmospheric Administration (NOAA) and geophysicist **Marcia McNutt** as head of the USGS and science advisor to the Cabinet-level Secretary of the Interior.

A 2003 study by the National Science Foundation found that half of all doctorate-holding life scientists and at least two-thirds of physical scientists were working outside of academia, in either government or industry. In specific fields, such as engineering or computer science, the majority of graduates expect nonacademic employment. In the same 2003 NSF study, only 2% of computer scientists and engineers were employed as professors in colleges or universities (Hall 2007, 186). The line between academia, government, and industry is not always clear in the United States, however. Many women scientists move across

these various sectors of employment over the course of their careers, working in government but holding honorary affiliations at universities or teaching part-time at either the beginning or retirement phase of their careers, holding faculty appointments but consulting on specific government projects, or working for private companies that support government and military needs.



Aeronautical engineer Sheila Widnall, 1993. Widnall was the first female Secretary of the U.S. Air Force. (Department of Defense)

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Jobs for Women Scientists: Industry, Business, and Nonprofit Research

Throughout the twentieth century, there have been both advantages and disadvantages for women scientists working in industry, business, private research, nonprofit organizations, or self-employment. In the nineteenth century, many women were engaged in “amateur” science as independent natural historians, botanists, wildlife preservationists, ornithologists, geologists, anthropologists, and archaeologists. Even as the scientific disciplines were professionalized, and university training became a standard requirement, women with any level of scientific background might find employment in a variety of settings. Still, women scientists employed in private industry have not always had the advantages of built-in organizational structures (including mentoring networks) that women in universities or in government agencies have had, where scientists are often organized by field and, early on, university- or discipline-wide studies were commissioned and internal guidelines set. The federal Women’s Bureau tracked the employment status, titles, and salaries of government workers, and women in academia were able to track and advocate for women’s representation in specific disciplines. On the other hand, industry and business have sometimes had more flexible hiring and advancement criteria, and over the course of the twentieth century, many women were able to make careers for themselves that combined research and management.

The demand for scientists, and therefore opportunities for women, has been especially great in industries related to major technological and scientific advances over the course of the last century, such as computers, engineering, aerospace,

Mary Kies, First American Woman to Receive a Patent

Mary Dixon Kies (1752–1837) was the first woman to be granted a patent from the U.S. Patent and Trademark Office. Her 1809 patent was for the development of a new technique for using thread to weave straw for women’s bonnets and hats. A few years earlier, another woman, Betsy Metcalf, had invented a popular technique for braiding straw for hats, but Metcalf never sought a patent. Since early American women could not legally own their own property, few stepped forward to protect their inventions in their own names. The timing was right for Kies, however, as the U.S. government was limiting the importation of European goods and encouraging domestic manufacturing. The Patent Act of 1790 was passed to encourage American innovation, which was made possible by the new technologies of the industrial revolution. Many items previously produced by women in the home were shifting to factory production, and straw hat production, in particular, was central to the New England economy. All of this must have been apparent to Kies, convincing her to seek protection and validation for her idea. First Lady Dolley Madison reportedly singled out Kies and praised her for her work. Unfortunately, Kies’s original patent paperwork was destroyed, along with records of numerous other early American inventions, in a Patent Office fire in 1836.

pharmaceutical and medical research, materials sciences, and automotive, plastics, and other applied industrial fields. In 2006, among employed women with a science- or engineering-related degree (bachelor’s or above), a majority, some 58.5%, were employed in science-related occupations within business, industry, or nonprofit organizations. This is compared to only slightly above 13% of women with science degrees then employed at four-year universities or colleges and another 13% employed at secondary schools, two-year colleges, or other educational institutions. Teaching or university research, therefore, is not the primary employment of American women scientists. Still others (4.6% of those in science-related fields in 2006) have chosen self-employment, the majority of these as psychologists or computer scientists (NSF Table H-19).

The Industrial Revolution and then wartime labor and technological needs during World War I opened up new industries with needs for more chemists, physicists, engineers, and mathematicians. Although it was difficult for women to hold onto industry jobs after veterans returned from the war (a pattern repeated after World War II), and although jobs were cut during the Great Depression and employers preferred to give the few available jobs to men (with many companies practicing the idea of a “family wage,” i.e., the belief that men needed jobs more than women because men had families to support), many women scientists found

success throughout these decades in the areas of food development and production (including agricultural sciences), nutrition, and household products technology (Rossiter 1982). Although the post–World War II era also saw the creation of new industries, particularly in consumer product development and military technology, there was another backlash against women workers that included social pressure for women to leave paid employment after marriage. These policies, whether formal or informal, made it difficult for women to enter into the new technological and engineering fields that were exploding in the 1950s and 1960s. A few notable women scientists emerge from this time period, but they were often the exceptions in heavily male-dominated fields of this era.

Among fields in which women had a significant presence in private employment (business, industry, or self-employment) in the 1950s and 1960s were psychology (with women making up 10.25% of psychologists in the nongovernment and non-academic sectors by 1968), computer sciences (8.7%), and statistics (7%) (Rossiter 1995, 259). Despite early advances in fields such as psychology, however, women's numbers in psychology, earth sciences, and agricultural sciences remained relatively constant from the 1950s through the 1960s, while their numbers nearly doubled in the “hard” sciences of mathematics, chemistry, and physics, a sign of industry's labor needs due to rapid technological and scientific advances in the post–World War II era. Besides the large numbers of women employed directly by the U.S. government, throughout the 1950s and 1960s, government money flowed to private institutions, businesses, and nonprofit research centers, including medical research institutes, observatories, and corporations that directly supported government programs, such as engineering firms contracted by NASA.

The passage of the Civil Rights Act of 1964 and then the women's movement of the 1970s brought legislative and social pressures on private business to conduct their hiring and advancement practices in a gender-neutral manner, and to expand the numbers of women on their payrolls and in high-level positions. Decades after these shifts, however, women still face problems related to recruitment, retention, and advancement across employment sectors. One problem for private industry is in preparing women scientists for nonacademic careers. Despite the fact that a large number of women with science educational backgrounds will go on to work in industry, business, and private research centers, the primary emphasis during graduate programs is undoubtedly on the academic job market rather than opportunities in a variety of other research or business settings. Depending on the specific field, professors are less likely to have connections outside of academia to connect students with mentors and opportunities. Even worse (and, again, depending on the field or discipline), some professors may view corporate employment or business leadership positions as “selling out” on the purity of the research agenda. Last, the limitations of academic employment (long hours, low pay, slow

advancement) may do more to lead women to nonacademic careers than a choice among equally desirable opportunities. For example, one survey of women scientists employed in industry found that nearly one-third of the respondents “chose the business sector not because they were recruited into it, but because they did not feel welcomed into academia” (Catalyst, 1999).

The problem is not just with an insular academic culture, however, as once employees enter into nonacademic employment, it may be difficult to find other women as mentors or role models. The “glass ceiling” and the “old boys’ networks” form invisible barriers to women’s advancement into high-level positions, and create an informal paternalistic corporate culture that keeps women out of the information loop, fosters stereotypes that prevent supervisors from giving women important or difficult assignments, or sometimes discourages women from seeking those positions, especially in science-related fields, which are still seen as male fields (Catalyst, 1999). Even with legal protection against discrimination, women in private employment may also be subject to subtle forms of discrimination due to a lack of formal industry-wide policies or grievance procedures. Just as in academia, women’s professional organizations have sprung up by industry in an effort to bring women together and provide career advice, information about job openings, opportunities to present at conferences or participate in professional meetings, and mentoring relationships.

Scientists in business and industry may also need experience in management or in profit-related activities related to marketing and sales, and therefore are not necessarily focused only on research. Pharmaceuticals, the automotive industry, and new “green” technologies, household products, and chemicals—these are all examples of science-intensive industries that are also heavily profit-driven. Advancement in corporate or private industry is often based, then, not solely on educational background, but on management skills and experience acquired on the job. The numbers of women managers are still low in part because many business schools (programs for the MBA, Master’s of Business Administration) did not admit women until the second half of the twentieth century, and it has taken one or more generations for women to gain access to education and then employment, and then work their way to the highest levels. In 2006, women still made up only 21.6% of managers in science- and engineering-related positions; the greatest percentage of managers were found in the medical and health services fields, probably taking into account the large number of female nurse managers, while the smallest percentage of female managers were found in engineering (NSF Table H-34).

Individual women, of course, have excelled in industry, just as in other sectors, and private research has inspired a large number of female innovators and inventors. Chemist **Stephanie Kwolek** invented a fire-retardant fabric, Kevlar, while working for DuPont industries in the 1970s and 1980s; botanist **Wanda Farr**, the discoverer

of cellulose, worked for American Cyanamid Company and for Celanese Corporation of America in the 1940s; physicist **Katharine Blodgett** developed nonreflecting glass while working for General Electric; engineer **Edith Clarke** designed large electric power systems at General Electric in the 1930s and 1940s; and physicist **Joan Mitchell** spent her entire career at IBM, where she helped develop the JPEG image compression format. By the 1980s, women were gaining entry into higher-level managerial and even executive positions. Physicist **Betsy Ancker-Johnson** and economist **Marina Whitman** were both vice presidents of General Motors Corporation for a time, and mechanical engineer **Rodica Baranescu** had a long career as a manager at International Truck and Engine Corporation.

Women have also excelled as scientists at private, nonprofit research centers and institutions. Geneticist **Barbara McClintock** conducted her Nobel Prize-winning research on maize at Cold Spring Harbor Laboratory, and more recently, women have served as heads or directors of such institutions, including marine geologist **Marcia McNutt** as CEO and president of the Monterey Bay Aquarium



Edith Clarke, right, was one of the first female electrical engineers in the United States. (Bettmann/Corbis)



Geneticist Barbara McClintock. (National Library of Medicine)

Research Institute and atmospheric scientist **Susan K. Avery** as director of the Woods Hole Oceanographic Institution. Self-employment has also been an option in many fields, and some women scientists founded their own companies. Computer scientists and engineers have been most successful in this category, as rapid technological advances and new applications opened up new business models and opportunities: **Adele Goldberg**, founder of Parc-Place Systems; **Evelyn Berezin** of Redactron; **Sandra Kurtzig** of ASK Computer Systems; and **Roberta Williams**, founder of Sierra On-Line, a computer games company.

In the first half of the twentieth century, self-employment may have been the only choice for some women scientists, as opportunities in academia or business may not have been available, or may not have been desirable due to considerations of dual-career couples or geographical mobility. Botanist **Cynthia Westcott** entered private practice as a plant pathologist and popular garden writer in the 1930s after she was unable to obtain professional employment. In the later twentieth century, some women trained in the sciences took advantage of new technologies (television and the Internet) to launch careers in the popular media instead of

in research or teaching. Psychologists **Joyce Brothers** and **Ruth Westheimer** are two of the most recognizable names in popular culture, both of them pioneering the use of radio, television, and popular books for administering mental-health and relationship advice. **Susan Love** left an academic teaching position to create her own breast cancer foundation and advocacy group, a route followed by other health professionals, including physician and women's natural health advocate **Christiane Northrup** and epidemiologist **Mary Harris**, who created a foundation and a website for disseminating information on African American women's health. Others combined backgrounds and interests in science and journalism to become prolific and popular science writers, such as naturalists **Marcia Bonta** and **Anne LaBastille**, and science writers **Natalie Angier** and **Jane Brody**.

Private employment has often been seen as more flexible for women workers, with more dependable working hours, and more opportunities for advancement based on experience and skills acquired on the job. As in other employment sectors, women scientists in industry and business are concerned about issues of work/life balance, including accommodations for dual-career couples and childcare arrangements. Some have found that the corporate world offers more stable and predictable working hours, unlike academia, which expects sometimes 24-hour commitments to the laboratory or project. Others find that, in order to attract quality workers, some corporations have made efforts to implement generous family leave and other policies, such as dependent healthcare, on-site childcare, or family leave; these corporations are widely advertised as "family-friendly" places to work and are not subject to the bureaucracy and reluctance to change that can sometimes characterize academic or government employers.

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Work/Life Balance for Women Scientists

As more women have become scientists and taken their places in academic research, industry, business, and government, has the profession of science become more family-friendly? Finding a desirable and manageable balance between working life and family life is something with which all working women, but especially working mothers, struggle. The issue seems to be compounded for women in the sciences, not only because of the demanding work hours and conditions, but because of the sense that science is still a primarily male profession. Women scientists in a variety of employment settings are less likely to have female support or role models, and more likely to feel the need to prove themselves as capable of performing in male-dominated fields and capable of putting in the required time and energy to succeed.

In his controversial 2005 address on women in the sciences, Harvard University president Lawrence Summers acknowledged that scientific research and faculty positions offer little flexibility, often demanding that the lab come before family and social life. Summers presented, as one of the reasons that there are fewer female tenured faculty scientists, the idea that women may be less willing to devote the time, energy, and sacrifice necessary to reach the highest levels of this career path (Summers 2005). The problem, of course, is not specific or



Industrial psychologist and engineer, Lillian Gilbreth, 1944. (AP/Wide World Photos)

unique to academic science, nor is it necessarily specific to women, as male employees now frequently expect more flexibility and balance in order to enjoy and participate in family life as well. Still, the issue of flexibility and responsibility for the care of children seems to affect women disproportionately. Even Summers, as the president of perhaps the most prestigious institution of higher education in the nation, could only wonder at the fact that Harvard will pay tuition for college-aged children of faculty, but offers nothing in the way of childcare subsidies for families with young children. Unfortunately, Summers did not go on to explain how, as president, he might address or remedy this situation. His combined remarks about women's interest in, aptitude for, and commitment to careers in science led to Summers's resignation; as he was replaced in 2007 with Harvard's first female president in the university's 370-year history, it will be interesting to see if the priorities or focus on such issues will shift.

The conflict between work and family life is, again, not particular to science or to academia, although there are some specific issues related to the university setting. It is also a larger social and political issue involving the historical role of women in the workplace, ideas about gender roles in marriage and parenting, and access to affordable and quality childcare. Except for anomalous periods such as the World War II era of unprecedented female workplace participation, the number of working mothers has steadily increased over the course of the twentieth century. In 1940 (before the outbreak of the war), only 10% of married mothers worked for wages. This number rose to 36% in 1975, and reached more than 50% by the late 1980s (Coleman, Ganong, and Warzinik 2007, 147). By the end of the first decade of the twenty-first century, an astounding 70% of married mothers were in the labor force at least part of the year, and 57% of mothers with infants worked for wages (U.S. Census Bureau 2008a; U.S. Census Bureau 2008c). These numbers vary by race, as black women, for example, have historically had higher labor force participation. In 1960, only 18% of married white mothers of preschool-aged children worked compared to 31% of married black mothers (Coleman, Ganong, and Warzinik 2007, 147). That gap is closing; as of 2005, some 70% of white mothers were in the workforce, compared to 76% of black mothers, and the lowest numbers were found among Latina mothers, 59% of whom worked (U.S. Bureau of Labor Statistics 2005).

The burden of childcare (either providing it or securing it) and of household work also falls disproportionately upon women, whether married or single. While more than 70% of mothers are now in the paid labor force, the other 24% of married mothers of young children stay home full-time to care for children (U.S. Census Bureau 2008a). Despite much recent attention to the stay-at-home father as a new phenomena, and despite the very real numbers of actual men who take on that role, as a percentage of overall parenting arrangements, full-time fatherhood still accounts for only a tiny minority of family arrangements. In 2008, the U.S. Census Bureau

Science and Surrogacy

The controversial area of reproductive science and technologies exploded into the public consciousness in the early 1980s. Just as the birth-control pill of the 1960s had separated sex and reproduction, scientists now offered the possibility of pregnancy without sexual intercourse at all (through *in vitro* fertilization, or IVF) and of pregnancy and mothering as two separate roles for women (through surrogacy). The first “test tube” baby was born in England in 1978, the product of IVF. The first woman to receive money as a surrogate was in 1980, but in the United States, the case that brought surrogacy to public attention was that of Mary Beth Whitehead, who had been artificially inseminated with the sperm of a man whose wife was unable to have children. After giving birth in March 1986, Whitehead decided she wanted to keep the baby, who was not genetically related to her. The courts, however, upheld the surrogacy contract and granted custody to the biological father, choosing genetics over a biological or emotional definition of motherhood through pregnancy. The issue raised debates that continue today, even among feminists, most of whom support a surrogate’s right to use her body in such an arrangement, and applaud technological advances that give infertile women more choices, but with others criticizing the potential exploitation of “renting out” a woman’s womb.

reported 140,000 full-time stay-at-home fathers out of a total of 22.5 million married couples with children under the age of 18 (U.S. Census Bureau 2008a). While that is a significant jump from even a decade ago, that still amounts to roughly only 0.06% of married households with young children and does not include single fathers, fathers working out of their homes (which would presumably make them more available in family life, regardless of their involvement in actual childcare), fathers working part-time, or fathers temporarily staying home with children (due to short-term unemployment, for example), so the actual numbers of men more involved in childcare and domestic life than even a generation or two ago is probably much higher. Still, the 140,000 self-identified full-time stay-at-home fathers must be compared to the 5.3 million married mothers who identify as stay-at-home parents. The responsibilities of work and family life are compounded for single parents and, in 2008, nearly 84% of single-parent households were headed by women, with more than 70% of those women regularly employed (U.S. Census Bureau 2008b).

Historically, many professional women of the early twentieth century felt compelled to choose between career and family. An astonishing number of early professional women scientists either never married or, if married, remained childless. Obviously, there are a variety of reasons why a couple (then or now) does not

have children, but for at least the first half of the twentieth century (and longer in some fields), young women would find few role models for combining a high-level career with a fulfilling family life. One notable exception was **Lillian Gilbreth**, who not only had a long and productive career as an industrial management engineer, but was famous as the mother of twelve, a life story chronicled in the book (and later the film) *Cheaper by the Dozen*. Gilbreth's case was even more unique in that her family *was* her laboratory, an experiment in itself to support her research on efficiency. In the 1950s and 1960s, it was common practice for single women to be asked in employment interviews if they planned to marry, and wives were asked when they planned to start a family. Also in those years, women who became pregnant were expected to quit their jobs, and there were no formal maternal-leave policies. Most universities, especially, had nepotism rules, sometimes unwritten, under which husbands and wives could not work in the same department, or sometimes even in the same institution.

Whereas the social and institutional constraints on women's careers and family choices were more obvious or explicit in the early part of the century, subtle pressures still remain. Despite the women's movement and social and political advances in women's status at home and in the workplace, women still not only bear and nurse children, but find themselves responsible for the care of young children and for the majority of the housework. These biological and family demands interfere with not only the educational demands of science careers and the tenure-track clock in academia (which disadvantages women across disciplines, not just in the sciences), but also with the often around-the-clock demands of laboratory research or the extended travel time of fieldwork.

Whereas today's young woman might consider options such as being a stay-at-home parent, telecommuting, or part-time or flex-time work, it has been (and remains) difficult to work part-time in many scientific fields, especially research-intensive positions or tenured academic positions. Of course, many women have found ways to have both a career and a family, usually depending heavily on a supportive spouse (often also a colleague or work partner), other family members (grandparents), or paid childcare arrangements, whether in-home or outside the home. In their memoirs and interviews, women scientists throughout the century never fail to make note of the choices and domestic arrangements that made their work possible, something rarely found in the career narratives of professional men. A 2006 report by the National Science Foundation found that of women with science degrees who were not currently employed, the largest percentage (39.6%) identified "family responsibilities" as the reason for their unemployment; this was compared to only 5.4% of unemployed men who gave "family responsibilities" as a reason (the largest number of men, more than 70%, absent from the workforce gave their status or reason as "retired") (NSF Table H-12). Accounting for

part-time work, a viable option in some but not all employment sectors, the majority of part-time scientists are also, not surprisingly, women. Women made up 69.2% of part-time scientists in 2006, and the majority of those (56%) again cited “family responsibilities” as the reason for their part-time status, compared to only 18% of men employed part-time listing “family responsibilities” as the reason (NSF Table H-11). These numbers highlight the choices women must make at various life stages, and the fact that women are more likely to accommodate their careers around family responsibilities than men.

When it comes to even getting a job in the first place (whether in academia or industry), some feminists fear (and many professional women sense) that “employers typically see a man’s family as evidence of his stability and dedication to work . . . while a woman with a family is often viewed as less serious about her career” (Hall 2007, 59). Another interesting find, given the history of high-profile science couples in the twentieth century, is that female scientists who marry are overwhelmingly more likely to marry another scientist than are male scientists who marry. Separate surveys in the 1990s and early 2000s showed, for example, that 68% of married female physicists and 52% of married female chemists were married to other scientists, compared to only 17% of married male physicists and 37% of married male chemists (Hall 2007, 61). Whether this is a question of convenience, compatibility, understanding, or shared interests and drive, it may also be that high-level career women find nonscientist (or nonprofessional) men threatened by their education and ambition. Of course, personal relationships between similarly situated professionals present a new set of problems related to both partners finding appropriate jobs in the same field. In academia, this is known as the “two-body” problem, and often leads to one partner having to accept a lesser or temporary position.

Getting pregnant or having a young child might also put women off the tenure track or the job search for a year or more, further placing her career second and jeopardizing her future prospects. Gail Simmons, a biologist and dean of science at the College of New Jersey, offered advice to women seeking to combine an academic science career with family life by recalling her own process of interviewing for a position while mothering an infant. Simmons joked that she was surprised to find that even fellow biologists “prefer not to be confronted with the mammalian nature of a job candidate” (Simmons 2005). A generational shift has begun, however, and young women in the twenty-first century have created public conversations about these dilemmas and offer support and solutions to one another. Toxicologist Emily Monosson compiled a 2008 collection of personal essays entitled *Motherhood, the Elephant in the Laboratory*, with one reviewer enthusiastic that “these brief life stories demonstrate that women professionals do not have to play by men’s rules to have a career.” The stories of these women and others

Women and HIV/AIDS

The human immunodeficiency virus (HIV) that causes AIDS (acquired immune deficiency syndrome) was first identified by the U.S. Centers for Disease Control in the early 1980s. Because the earliest cases were found among homosexual men, the disease was referred to as “gay cancer” in the early months of the CDC’s investigation. This identification of the disease with gay males meant that it took some time before the disease was acknowledged in women; even years later, when the virus was found in other at-risk groups (including hemophiliacs and intravenous-drug users), there was still a denial by many that women were at risk through heterosexual intercourse. By 2009, however, women accounted for 1 in 4 AIDS diagnoses and deaths in the United States and more than half of people living with AIDS worldwide. Of those, more than 70% of women afflicted contracted the disease through heterosexual activity. HIV/AIDS is also an issue of concern to women globally because of the possibility of transmission to children through pregnancy and breastfeeding, and because of the high-risk activity of female sex workers. Although some new promising drug treatments may alleviate the symptoms of the disease and prolong life expectancy, there is still no cure or vaccine, and public health efforts must focus primarily on education and prevention.

highlight women’s efforts at balancing a career at any stage with pregnancy, breastfeeding, and childrearing, and provide examples of a range of options practiced by women scientists, including part-time work, full-time childcare, leaves of absence, job sharing, or independent research and self-employment.

The women’s movement and government equal-opportunity legislation changed not only the makeup of the college science classroom, but of academia and the professional workplace as well. Women faced fewer social or cultural barriers to achieving high-level goals and positions, but the institutional framework for supporting working mothers with family-friendly policies (including, but not limited to childcare) has not necessarily changed since the 1960s and 1970s. It is still usually the woman’s (mother’s) role to “juggle” work and family, and to find a way to make it work on an individual basis. The reality, in most instances, is that the workplace and the men involved are not expected to accommodate women who choose to be there. These are precisely the kinds of sociological and policy issues that have been taken up by women social scientists, such as **Sylvia Hewlett**, who created the Center for Work-Life Policy (<http://www.worklifepolicy.org>) to examine such issues, publish research, and make policy recommendations related to women, families, and work throughout the life cycle.

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Minority Women in the Sciences

Accounting for 38% of new science doctorates and only 31% of science and engineering faculty, women *are* the minority in science. Compounded by women's even more glaring minority status in specific low-representation fields (such as engineering, physics, mathematics, and computer science), women and girls from racial and ethnic minorities face additional obstacles when it comes to education, resources, opportunity, and employment. According to National Science Foundation statistics for 2006, less than 2% of doctoral-level engineers were black and barely 10% were women of any race. The actual numbers of black women in specific fields are even more dismal. Although women consistently earn the majority of bachelor's degrees awarded overall to African Americans, in 2006 they held 38.7% of science and engineering doctorates, a number consistent with women's overall presence in the sciences. Broken down by field, however, these were concentrated in psychology, social sciences, and the biological or life sciences, with the numbers of black female engineers, computer scientists, mathematicians, or physical scientists so negligible as not to be recorded (NSF Table H-7).

Of course, the numbers and status of minority women scientists vary by racial group as well, with different challenges as well as different cultural, educational, and familial expectations for different groups of women, whether African American, Asian American, or Mexican American. Despite the effects of sexism and racism, however, individual women of color have made significant inroads into specific areas of science education and employment, thanks to legislation and changing social attitudes in the second half of the twentieth century. While the percentages of women of color in science relative to men of their same racial or ethnic groups would indicate that race and sex are not always compounded as disadvantages, it is important to point out that the actual numbers of African Americans, Asian Americans, Latinos, and Native Americans (men and women) in the sciences is still quite low, and that racial minorities remain grossly underrepresented in science and engineering relative to their numbers in the overall U.S. population.

African American women had some early successes in the sciences, bolstered by the opening of black colleges and universities, and the first racially integrated colleges, in the late nineteenth century. Many black women scientists of the early twentieth century were trained as undergraduates in these colleges, and broke through the barriers to graduate study to earn doctorates in many fields by the 1930s and 1940s. **Ruth Howard-Beckham** earned her Ph.D. in psychology (1934); **Marie Daly** was the first African American woman to earn a Ph.D. in chemistry (1948); and **Phyllis Wallace** earned a Ph.D. in economics (1948) and **Evelyn Boyd Granville** a Ph.D. in mathematics (1949), both from Yale. The 1950s and 1960s saw many black women advance in the medical sciences.

Phyllis Harrison-Ross was an M.D. and a pediatric psychologist; **Jewel Plummer Cobb** held a doctorate in cell biology; and **Jean Harris** was an M.D. and later the mayor of her town.

Despite some individual successes in the first half of the twentieth century, and despite the legislative gains of the civil rights movement, African American women continued to face issues of fewer family resources, lower socioeconomic backgrounds, inferior educational opportunities, and lack of mentors. The author of the 2008 book *Swimming Against the Tide: African American Girls and Science Education* cautions against generalizing about “women in science” without consideration of how the economic and racial status of minority women impacts their specific educational and employment opportunities beyond the issues facing all women. In the case of African American women, there are some unique disadvantages but also some advantages or positive forces impacting their experiences of science. For example, within the black community, there is often an equal commitment to the education of boys and girls, propelled by the historical reality that black women will have to work to support their families, the desire for upward mobility within the black community, and the historical value placed on access to education. This would be borne out in the greater numbers of black women going on to earn college degrees than black men, who face their own specific challenges related to sex, race, and economic status or expectations. In other words, the particular economic and historical position of black families creates a different set of gender expectations than those found in the white community. While young white women may have greater access to teachers, books, and science equipment, there is not an overall cultural expectation of college attendance and future employment, the assumption more often being that white women will marry and will make a “choice” to pursue a career *or* a family (Hanson 2008).

Women in the Asian American community face their own set of stereotypes, cultural assumptions, and expectations. While the stereotype of Asian women is submissive and quiet, many immigrant families also expect academic success for their children, and there seems to be less of a gender gap between the science education and achievement of Asian American male and female students. While their educational goals, family expectations, and support may be the same as that offered to boys, Asian American girls and women are also subject to institutional discrimination along the science pipeline, just like women of other racial subgroups (Lee 2008).

Despite the stereotype of Asian American overrepresentation in the sciences, Asian American students (male and female combined) made up only 10.8% of all enrolled engineering undergraduates in 2006, a small percentage of the total, but the largest of any nonwhite group (Hispanics made up 9% of all undergraduates in engineering, and African Americans just 5.7%). Of the Asian American students, however, only 20% of those were women (NSF Table B-10). Moving to the graduate level, Asian American women accounted for only 6.5% of all female

science and engineering graduate students in 2006 (NSF Table D-2). Finally, although the perception among some has been that the Civil Rights Act and political movements of the 1960s and 1970s did not represent Asians—a less vocal minority group in American society and history—the fact is that Asian Americans significantly outnumber African Americans or Hispanics as employed doctoral-level scientists and engineers (NSF Table H-9), and they outnumber blacks and Hispanics at all faculty levels within academia (NSF Table H-25).

Asian American women have achieved at the highest levels of science in academia and in business or industry. **Chien-Shiung Wu** was an early and renowned nuclear physicist, earning her Ph.D. from the University of California at Berkeley in 1940. Of the next generation, **Alice Huang** (Ph.D., 1966) was a microbiologist who taught at major universities of the East and West Coasts and served as president of the American Society of Microbiology. **Susan Wu** is an aeronautics engineer who has consulted privately for NASA and other agencies, and **Jennie Hwang** is a materials engineer and international businesswoman who consults on green technologies and on motivating women and minorities in the sciences.

Mexican Americans and other Hispanics face similar issues to those faced by African Americans as far as economic disadvantages and fewer educational resources and role models, but Latinas may have additional barriers of living in immigrant and migrant communities, and of language obstacles between school and home and between generations. They may also come up against cultural expectations that their primary adult role will be domestic, as mothers, rather than professional. Still, in 2006, Hispanic women earned 56% of all science and engineering bachelor's degrees awarded to Hispanics; however, this only accounted for 8.5% of the degrees awarded to all women (NSF Table C-14). As recipients of STEM doctorates, Hispanic women earned more Ph.D.s than either black men or Hispanic men, but still earned only 5.6% of doctoral degrees granted to all women (NSF Table F-12). Hispanic women students are supported by prominent Hispanic leaders who provide role models and are committed to highly organized professional communities involved in educational outreach and mentorship programs.

By the 1970s and 1980s, many women of color achieved important “firsts” in fields and positions that were slowly opened to American women. **Mae Jemison** became the first black female astronaut and **Ellen Ochoa** became the first Hispanic astronaut. **Antonia Novello** was the first female (and first Hispanic) Surgeon General, serving under President George H. W. Bush; a few years later, President Clinton also selected a woman as Surgeon General, **Joycelyn Elders**, also the first African American in that position. Physicist **France Anne-Dominic Cordova** worked for NASA and in 2007 was named president of Purdue University, and cell biologist **Lydia Villa-Komaroff** had a career in academia before becoming Chief Scientific Officer of a biotechnology company.

Many minority women scientists have taken as their topic of research and study racial minorities in health-care, life sciences and diseases, and social sciences. Native American women especially were often the first and among the few native peoples in their fields. Anthropologist **Beatrice Medicine** focused her attention on the needs and status of Native American women and families. **Lora Shields** received one of the earliest doctorates in botany (from the University of Iowa in 1947) received by a Native American; her research focused on the effect of uranium mining and nuclear testing on vegetation on Navajo lands and reservations. **Agnes Stroud** was a biologist who also looked at the effect of radiation on human health and was the first Native American woman scientist at a national research lab.

Many Latina and African American women also aligned their research interests with issues facing their communities. Sociologist **Maxine Baca Zinn** focused her research on Latino families and Mexican American women in particular, and psychologist **Jane Delgado** has been at the forefront of the Hispanic health movement. **Niara Sudarkasa** and **Faye Harrison** are both anthropologists who study people of African descent throughout the world; **Mary Harris**, who holds a doctorate in genetics, runs a foundation and website devoted to African American health issues; **Angela Ferguson** (M.D., 1949) and **Helen Ranney** (M.D., 1947) both studied sickle-cell anemia, a disease that disproportionately affects African Americans.

Gay and lesbian issues are a new area of minority concern among science and engineering professionals, with similar issues of education, policy, and professional research interests. Some have identified a “lavender ceiling” preventing the advancement of lesbian women within the professions that is a combination of sexism and heterosexism. Laws against discrimination based on sexual orientation are fairly recent, and vary by state and industry. There are no figures on the numbers of lesbians in science but, as in the other professions, lesbian women are concerned about access to employment benefits, partner or spousal rights, healthcare, and



Astronaut Mae Jemison on Spacelab-J, 1992. (NASA)

work/life balance. The gay and lesbian community has been organizing since the 1960s, but the movement did not come into its own politically until the 1990s. The issues are ongoing and lesbians stand to gain from, but have not always been heard within, both the feminist and the larger gay-rights movements.

In terms of scientific research itself, various medical and psychological explanations for homosexuality date back to at least the nineteenth century, but new inquiries into unique gay and lesbian health issues, mental health, and the scientific understandings of homosexuality itself (the nature-versus-nurture question) have gained momentum just since the 1990s. In the broadest sense, lesbian issues are women's issues and should concern the larger women's movement and inform larger debates about women in science and as subjects of scientific research. In 1993, the American Medical Women's Association (AMWA) issued its statement on lesbian health, and in 1999 the Institute of Medicine of the National Academy of Science published a book-length report on "Lesbian Health: Current Assessment and Directions for the Future" (Solarz). The National Organization of Gay and Lesbian Scientists and Technical Professionals (NOGLSTP) is an affiliate of the American Association for the Advancement of Science. The Gay and Lesbian Medical Association (GLMA) is also a major national group that serves as both a professional member organization and a research and advocacy group on issues related to healthcare specific to the gay, lesbian, bisexual, and transgender (GLBT) community. The GLMA also publishes its own journal.

What is needed for the future of minority women in the sciences are the same issues that affect all women in the sciences: education, mentorship, funding, opportunity, and access to all levels of employment. Racial minority women often face double the hurdles, however, as they move through the science education and career pipelines. Many national professional organizations, either for women or for specific racial minority groups, serve as important clearinghouses for information on research opportunities, educational programs, internships, mentorships, prize competitions, and conferences. Some of these that are not specific to women include the American Indian Science & Engineering Society, Society for Advancement of Chicanos and Native Americans in Science, National Society of Black Engineers, Society of Mexican American Engineers and Scientists (MAES), and Society of Hispanic Professional Engineers.

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Disciplines

Aerospace and Astronautics

Aerospace science encompasses the theory, engineering, and manufacturing of aircraft and spacecraft for flight both within and outside of the Earth's atmosphere. *Astronautics* refers specifically to the science and technology of space flight, including manned space flight, and is thus one of the newest scientific disciplines, emerging as a distinct field only in the mid-twentieth century. In the United States, the space flight program is run by a government agency, the National Aeronautics and Space Administration (NASA), founded in 1958. Aerospace science, or aeronautics, and astronautics includes not only astronauts, but scientists and engineers working within a variety of research and technical support areas in both industry and government settings. Persons working within the aerospace and astronautics fields may have advanced degrees and experience in physics, electrical and mechanical engineering, mathematics, chemistry, environmental sciences, astronomy and astrophysics, biology, and even medicine. The first generation of American astronauts were usually trained military pilots, but the astronaut program eventually recruited doctoral-level scientists and engineers with specialized knowledge in a range of disciplines.

Although early mathematicians, physicists, astronomers, and writers theorized the possibility of space travel (and of flight in general), aerodynamics and rocket science were technological triumphs of the twentieth century. The American aerospace science industry and astronaut training programs are the result of the Cold War-era "space race" between the United States and Russia. After Russia launched the *Sputnik* space satellite in 1957, the United States began its own space program in 1958; 10 years later, American astronauts landed on the moon. The Russian *Mir* space station was launched in 1986 and, in the post-Cold War era, construction of the international space station began in 1998, with scheduled completion by 2011. Over the past 50 years, then, the American space program has evolved from competition to cooperation, and from individual unmanned rockets and satellites to a full-crew shuttle program, and American women have been involved in all phases.



Commercial pilot Jerrie Cobb helped develop astronaut training tests for women in the early 1960s. (Bettmann/Corbis)

The first woman in space was Russian cosmonaut Valentina Tereshkova in 1963. At that time, the United States did not yet allow women into the astronaut training program, and it would take another 20 years until the United States put its first woman in space, **Sally Ride** in 1983. It was not until 1978 that NASA opened the astronaut program to female candidates, but women had already played a significant role in the development of the space program to that date. It was a woman who helped write the legislation that led to the founding of the National Aerospace and Space Act two decades earlier. Congressional researcher Eilene Galloway had written a report on “Guided Missiles in Foreign Countries” and was involved in drafting treaties and legislation regarding rules for peaceful international space exploration, leading to the creation of NASA in 1958.

The following year, capitalizing on the space race combined with public interest in female pilots such as Amelia Earhart and the Women’s Air Force Service Pilots (WASPs) during World War II, Dr. William Randolph Lovelace established a privately run Woman in Space program. Pilot **Geraldynne “Jerrie” Cobb** helped create physical-fitness tests for women and, in 1961, 13 female pilots, including Cobb, passed the training tests at Lovelace’s New Mexico facility. But politics and social restrictions still interfered with women’s entrance into the space program, and, without official support from NASA, the military put a stop to further testing and training of women pilots. Cobb and the others appealed to Congress in 1962, claiming sex discrimination, but NASA representatives and male astronauts testified that the women lacked training as military pilots and lacked engineering degrees. Of course, at that time, women were routinely excluded from those very opportunities that would have opened this career path. Although Congress would not require NASA to establish a women’s training program, Cobb and the other pilots were proud that they passed the same physical and psychological requirements as the male astronauts who

Eilene Galloway

Eilene Marie Slack Galloway (1906–2009) helped research and write the National Aeronautics and Space Act, which led to the creation of the National Aeronautics and Space Administration (NASA) in 1958. Galloway, a Congressional researcher, began working as early as 1941 on guidelines and legislation regarding peaceful international space exploration, and in 1958 worked with Senator Lyndon B. Johnson on the Congressional hearings advocating the creation of a U.S. space agency. She later served on numerous advisory committees for NASA and was a founding member of the International Institute of Space Law. Galloway was not a scientist, but helped pave the way for American space exploration and technological innovation, ushering in the era of the space race and the moon landing. She was honored for her contribution to the space program with several NASA awards and was also named a fellow of the American Astronautical Society and, in 1987, the first recipient of a Lifetime Achievement Award from Women in Aerospace. In 2006, she was the first woman to be named an Honorary Fellow of the American Institute of Aeronautics and Astronautics. Galloway died in 2009, just a few days before her 103rd birthday.

eventually flew missions for NASA, and considered themselves the “First Lady Astronaut Trainees” (or FLATs).

Although the Navy and Air Force began training women as pilots in the mid-1970s, after the Apollo program ended, NASA eliminated the jet-pilot requirement for astronauts and began seeking candidates with science and engineering backgrounds, including women. In 1978, the first six women astronauts were chosen: Sally Ride, **Kathryn Sullivan**, **Anna Fisher**, **Margaret Rhea Seddon**, **Judith Resnik**, and **Shannon Lucid**. Ride was the first American woman to fly in space, Sullivan the first to walk in space; Fisher was the first mother in orbit, while Seddon’s pregnancy barred her from the early flights; engineer Resnik died in the *Challenger* disaster of 1986; and Lucid spent 179 days aboard the space station *Mir*, a record for any astronaut, male or female. During the 1980s, these women received a great deal of media attention, but each year, more women joined the program. In 1995, **Eileen Collins** was the first woman to pilot a space shuttle, fulfilling the dream of the original pilot trainees of the 1960s, and in 2007, **Peggy Whitson** became the first female commander of the International Space Station. By 2008, America’s fiftieth woman astronaut flew in space.

Besides the astronauts, all of whom have been highly skilled scientific specialists, many other women have been involved in NASA research and space missions. Women engineers and scientists compute orbits for missiles, rockets, and space

Karen Nyberg

In May 2008, astronaut Karen LuJean Nyberg (b. 1969) became the fiftieth American woman in space when she flew aboard the space shuttle *Discovery* on a 13-day mission to the International Space Station. Nyberg served as ground crew support before entering the astronaut training program in 2000. She studied mechanical engineering at the University of North Dakota and conducted graduate research at the University of Texas, Austin on thermoregulation control and human metabolic testing. She worked as an Environmental Control Systems Engineer for the National Aeronautics and Space Administration (NASA) after receiving her doctorate in 1998. She received a patent for work at the Johnson Space Center on a Robot Friendly Probe and Socket Assembly. Before taking her first shuttle spaceflight, Nyberg completed deep-sea training through a program called NEEMO 10, an underwater exercise to simulate and prepare for sending astronauts to the moon and eventually to Mars. Nyberg has been honored with numerous NASA achievement and technical awards.

vehicles, and develop new materials that can withstand the extremes of heat and cold in space and during reentry. Physiologists and psychologists analyze the physical and mental problems associated with weightlessness, motion sickness, and the gravity (G) forces experienced by pilots flying at high altitudes and reentering the Earth's atmosphere. Astronomers and astrophysicists provide data on the distance to the moon and planets, and the composition of those planets. Physician **Irene Long** became one of the highest-ranking officials at NASA in her position as Chief Medical Officer. **Christine Darden**, an engineer at NASA's Langley Research Center, created the computer software program used to simulate a sonic boom in a wind tunnel. She was also involved in redesigning aircraft to minimize the sonic boom because military aircraft sometimes reach supersonic speeds as they fly across populated areas.

Even more women have worked for companies and universities under NASA contracts as mathematicians, computer scientists, physicists, nutritionists, astronomers, metallurgists, meteorologists, materials and aviation engineers, psychologists, and medical personnel. **Margaret Hamilton** was part of a team at the Massachusetts Institute of Technology (MIT) that designed the computer systems for the Apollo command module and the lunar excursion vehicle. **Heidi Hammel**, also of MIT, and **Margaret Burbidge**, of the University of California, San Diego, are among the astronomers who were involved in the design of the Hubble space telescope and in correcting its flawed lens several years later. **Marjorie Townsend** designed and launched astronomical and meteorological satellites, and **Patricia**

Cowings taught the astronauts how to use biofeedback to control motion sickness. **Devrie Intriligator**, a physicist at the California Institute of Technology, analyzed data from the Pioneer spacecraft in orbit around the sun, and **Caroline Herzenberg**, then at the ITT Research Institute, had a grant from NASA to test Apollo lunar samples.

Women have now contributed to all aspects of the American aerospace and astronautics programs. Although the relatively small number of individual astronauts are highly celebrated by NASA and by the public, the efforts of an extensive and diverse group of scientists make space travel and exploration possible. The American Institute of Aeronautics and Astronautics (<http://www.aiaa.org>) is the primary professional organization for those working in this field, and women professionals are supported by Women in Aerospace (<http://womeninaerospace.org/>).

See also Astronomy and Astrophysics; Engineering; Physics

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Animal Sciences

The National Academy of Sciences (NAS) has a combined section for Animal, Nutritional, and Microbial Sciences. Although this categorization includes diverse fields of inquiry across several research interests, animal sciences as a separate field is usually defined by most college programs as encompassing research on livestock production, disease, and nutrition, which may require interdisciplinary training in agriculture, biology, chemistry, biochemistry, or zoology. Animal sciences may also include veterinary science, which itself is broken down by focus on small animal, large animal, or the subspecialty of equine or horse care. The broad field

of animal sciences is often the precursor, or undergraduate major, for entrance into veterinary school, for which women now make up the majority of students. By 2002, as many as 80% of new doctors of veterinary medicine were women. This is an almost complete reversal from 40 years ago, when only 5% of veterinary students were women. As in many scientific fields, however, the percentages reflect not only an increase in the actual numbers of women, but the lower numbers of men in the field, as the number of male veterinarians is down 15% since 1991 (Zhao 2002). Nationwide, women were a slight majority in the broader field of agricultural sciences, earning 51.5% of all bachelor's degrees awarded in 2006 (NSF Table C-14). This makes animal and veterinary sciences unique among the sciences, as women are underrepresented in nearly every other field, significantly so in fields such as engineering, physics, or math. As all advanced or doctoral-level work requires several years of rigorous science education, regardless of the field of study, this unprecedented gender shift could be explained, at least in part, by the flexibility associated with private veterinary practice (as opposed to a faculty research position) and the association of animal care (and small-animal care, in particular) as a "helping" profession (like human medicine or psychology), which may disproportionately appeal to more women than men (Maines 2007).

Of course, not all animal-science majors go on to veterinary or agricultural careers, as many scientists work on issues related to other nonlivestock or nondomesticated animals in diverse fields of biology, chemistry, entomology, environmental sciences, genetics, marine sciences, microbiology, nutrition, pathology, primatology, toxicology, or zoology, among others. Also, many students of agricultural sciences (an even broader field that might encompass animal sciences) are not working on issues related to animals at all, but on food crop production or irrigation, among other issues.

In 1900, more than two-thirds of the U.S. population lived rurally, a situation reversed by 2000, when more than 80% of the population lived in urban areas (U.S. Census 2006). As the nation's population spread further and further westward, different areas of the country became focused on food production to feed the entire nation. New technological developments were needed not only for larger-scale, nonsubsistence agriculture in the Midwest and West, but for transportation and processing of livestock and related products. In the late nineteenth century, agriculture became not only highly commercialized, but regulated by the government as well. The U.S. Department of Agriculture (USDA) was founded in 1862, the same year the Morrill Act spurred the establishment of the land-grant colleges in these new regions to teach "agriculture and the mechanic arts." Women were admitted to these public colleges in ever-increasing numbers, especially after 1890, and were educated for professional careers in the livestock, dairy, and poultry industries.

In the early twentieth century, the USDA became one of the largest employers of women scientists, researchers, and assistants.

Women have a long history of farming and animal care, and women's work in poultry and livestock production, care, and processing was essential to household income in the United States through the early twentieth century. This work led to numerous inventions and technological innovations by women related to farming and commercial agriculture. Some areas of animal sciences in which women have had particularly visible roles include creating new breeds and varieties of livestock. Melinda Boice, for example, was part of a University of Pennsylvania research team that produced the first calf by *in vitro* fer-

tilization, a 1981 breakthrough that was important for increasing production capabilities of farms (Stanley 1995, 44). Perhaps one of the most famous female animal scientists is **Temple Grandin**, whose work on animal behavior has had enormous implications not only for establishing humane treatment and slaughter standards for livestock, but for understanding human behavior as well. Another animal scientist whose work has implications for human health is microbiologist **Linda Saif**, whose work on animal viruses helped government and healthcare providers plan a vaccine response to the global SARS (Severe Acute Respiratory Syndrome) outbreak in 2002–2003.

Professional organizations for animal scientists include the American Society of Animal Science (<http://www.asas.org>) and the Association for Women Veterinarians (<http://www.womenveterinarians.org/>), which began as the Women's Veterinary Association in 1947, when there were only about 100 professional female veterinarians in the United States. As women's numbers in the field have grown, the AWV has taken on a broader range of advocacy issues related to women in the profession, such as scholarships and mentoring for female students, pay inequity, and maternity leave and other work/life issues.

See also Biochemistry; Environmental Sciences and Ecology; Genetics; Nutrition; Zoology



Temple Grandin attends a screening of HBO's 'Temple Grandin' at the Time Warner screening room, 2010. (AP/Wide World Photos)

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Anthropology and Archaeology

Anthropology is the study of human cultures, past and present, and combines the methods and questions of the natural sciences with the humanities and social sciences. Anthropologists study human behavior, customs, physical characteristics, and environments, and their work overlaps significantly with research in fields such as primatology, evolutionary biology, and psychology. Subfields or specialties include biological anthropology, physical anthropology, cultural anthropology, anthropological linguistics, and archaeology, the science of recovering the human material and physical past. The National Academy of Sciences (NAS) includes anthropology and archaeology under its Behavioral and Social Sciences section, but only a small number of anthropologists or archaeologists

have been elected to the NAS. Through 2008, there were only 66 NAS members in anthropology, 15 of whom were women. This is most likely a result of the lesser position of the social sciences in the NAS, however, and not a reflection of the number of professionals working in these fields at large.

As with natural history, botany, paleontology, or other field-study sciences, many women in the nineteenth and early twentieth centuries pursued anthropological and archaeological studies as amateurs. Beginning in the nineteenth century, however, the U.S. government became involved in ethnographic studies of Native Americans, recording valuable knowledge and collecting artifacts from groups who faced cultural extinction due to the policy of expansion. The Bureau of Indian Affairs was established in

1824, the Smithsonian Institution in 1855, and the American Museum of Natural History in 1869. At the turn of the twentieth century, many women writers and photographers went into the field as ethnographers to record (and often advocate for) Native American life. Alice Fletcher, who studied archaeology at Harvard and later lived among the Ohama Plains Indians, was among this generation. University departments soon replaced the amateur explorations and field studies of the earlier generation with professional museum development and management.

Franz Boas, Columbia University professor and creator of the first Ph.D. program in anthropology, was trained in physics and established empirical methods for anthropology that replaced the earlier evolutionary perspective of human cultures along a hierarchical scale of “civilization.” Some of the most prominent early professional women anthropologists worked with Boas, including **Ruth Benedict**, **Margaret Mead**, and **Elsie Clews Parsons**, who trained in sociology at Columbia but never held a university position. Parsons helped establish the *Journal of American Folklore* and was the first female president of the American Anthropological Association in 1941. Mead was later the first female president of the Society for Applied Anthropology. Women anthropologists of this generation began to pay attention to women as research subjects and argued for a cultural,



Anthropologist and folklorist, Ruth Fulton Benedict. (Bettmann/Corbis)

rather than biological, basis for human behavior. Mead, in particular, reached a nonacademic audience and expanded interest in the work of anthropologists with her controversial works on sexuality and sex roles.

In the 1970s and 1980s, a new generation of feminist anthropologists introduced new theories and methods to the field. Feminist anthropologists, such as **Eleanor Leacock**, who earned her Ph.D. from Columbia in 1952, as well as a new generation of archaeologists and primatologists, questioned methods that assumed gendered hierarchies were natural. Anthropology was revolutionized by the new women's liberation movement of the early 1970s, which provided a theoretical basis for questioning the "naturalness" of patriarchy around the world. Marxist feminists rejected the belief that women were unproductive or dependent members of society, showing that man-the-hunter had turned into modern man-the-wage-earner, but that women's reproductive work and household contributions had been ignored by anthropologists and historians. Since the 1980s, queer theory has raised questions about the nature of gender identity and sexual orientation, further challenging the idea of a unified definition or experience of "woman" (or "man") across cultures and time.

Although the primary image of the anthropologist is one of the fieldworker, as social scientists, they may also work in a variety of university, government, and private institutions as qualitative analysts and policy consultants. Current anthropologists look at culturally specific beliefs surrounding women's roles and a range of issues such as menstruation, childbirth, motherhood, women's education and wage-earning, female circumcision, sexuality, women's experiences of poverty and development, and women's roles and family life within specific communities, such as in the work of **Johnnetta Cole** or **Niara Sudarkasa** among Africans and African Americans, or **Beatrice Medicine's** work among Native Americans. This work is supported professionally by subgroups within the American Association of Anthropology (AAA) such as the Association for Feminist Anthropology (<http://www.aaanet.org/sections/afa/>), Committee on the Status of Women in Anthropology (<http://www.aaanet.org/cmtes/coswa/index.cfm>), and Society of Lesbian and Gay Anthropologists (<http://www.uvm.edu/~dlrh/solga/>).

Feminist archaeologists seek to recover women's material past for insight into women's roles and contributions. They recover artifacts, buildings, and even physical bodies (such as skeletons or hair for analyzing DNA) for clues about gender, class, and religious belief. Supporting the work of anthropologists and historians, archaeologists can provide the material evidence for understanding women's economic contributions and the gendered divisions of labor through analysis of tools and other household items. Feminist archaeologists have also been interested in recovering an alternate female past, challenging the history of

patriarchy itself through analysis of material items related to matriarchal and goddess societies, such as religious and fertility figures.

The late-nineteenth- and early-twentieth-century era of exploration, colonization, missionary work, and world travel opened up interest in exotic peoples and cultures, past and present, giving new methods and purpose to archaeological expeditions, which were now funded and organized by governments, universities, and museums. There were almost no professional women archaeologists before 1915. There were not only limitations of training and access to university positions (a problem for women in all fields of science), but women in this pioneer generation of archaeologists also often had to deal with prejudices and obstacles from the communities and regions in which they studied; it was often seen as unsuitable for women to interact with local men, to dress in Western attire, or to take on leadership roles in organizing local male field workers, for example.

Some women pursued the work as amateurs, self-funded, or were married to male archaeologists and accompanied them on research expeditions. Women also had to struggle against a particular view of the archaeologist as a fearless male adventurer, the “Indiana Jones” type. Women were seen as particularly unsuited to scientific pursuits that involved field work (not only archaeology, but also geography, geology, or zoology, for example), which required not only time spent in the field among male colleagues, but time spent away from the home and families, literally digging in the dirt. This view of archaeological work as men’s work was long-lasting; as late as 1981, Harvard University explained the lack of women in its archaeology department by declaring that “women as a group are not attracted to the discipline,” even though women at that time were receiving one-third of all doctorates in anthropology and archaeology (Irwin-Williams 1990, 3).

By the 1930s, archaeology was established as an academic discipline, but few women stood out in the field, especially in the United States. Some of most prominent American women were working as part of husband–wife teams during these years (Ann Morris or Elizabeth Campbell), while others worked alone (**Florence Hawley Ellis** or **Frederica De Laguna**, who served as president of the American Anthropological Association in 1967). Prominent women of the next generation included Marjorie Ferguson Lambert, Dorothy Hughes Popenoe, and Hannah Marie Wormington, who in 1968 was the first woman president of the Society of American Archaeology. Beginning in the 1970s and 1980s, feminist archaeologists, like anthropologists, made interventions into the nature-versus-nurture debate, and some have built careers amassing significant artifact collections, such as **Joyce Marcus’s** collection on Latin America at the University of Michigan Museum of Anthropology. The work of professional women archaeologists is supported by groups such as the Society for American Archaeology

Lucy Changes History

A 3.2 million year old woman made an important contribution to science in the twentieth century. “Lucy” (*Australopithecus afarensis*) is the name given to a partial skeleton found in Ethiopia in 1974 and, at that time, the earliest bipedal (walking on two legs) hominid specimen, a link between modern humans and the great apes. Lucy was discovered by a team that included American anthropologist and museum curator Donald Johanson. She is only three and a half feet tall and resembled a chimpanzee, but her leg and pelvic bones confirmed her ancestry to modern humans and her small skull confirmed the evolutionary fact that humans walked upright before their brains developed to a larger size. In 1994 an even older hominid skeleton was found, pushing the date of bipedalism back to 4.4 million years ago. Lucy’s skeleton is preserved at the National Museum of Ethiopia, although a reconstructed replica is available for display and research in the United States, at the Cleveland Museum of Natural History.

Women’s Interest Group (<http://www.saa.org/ForMembers/InterestGroups/WomeninArchaeologyInterestGroup/tabid/158/Default.aspx>). Some of the most significant work on feminist theory and feminist archaeology has been done, however, by scholars and archaeologists from Britain, Canada, and Australia, as the research is often international in scope and not specific to one country.

See also Paleontology; Primatology

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Astronomy and Astrophysics

Astronomy is the study of the entire universe outside of the Earth's immediate atmosphere and may include astrometry (charting the positions and movements of stars or planets) and astrophysics. Astrophysics includes the study of the physical properties of stars, planets, and galaxies (temperature, light, chemical makeup) as well as theoretical astrophysics, nuclear physics, quantum physics, and cosmology. Astrophysics may therefore be studied under astronomy or physics programs in colleges and universities. With the availability of modern telescope equipment, observational astronomy is also one of the few branches of science that still maintains a thriving worldwide amateur community. Indeed, the International Astronomical Union (IAU) declared 2009 (the 400-year anniversary of Galileo's discoveries) the International Year of Astronomy to encourage citizens of all ages to explore the skies and the universe.

Observational astronomy has a long history, as humans have always been curious about activities in the skies. The observation of other planets, stars, and the sun and moon have had important influences on human culture, from religious beliefs to agricultural calendars to scientific revolutions, all of which preceded modern scientific methods and understandings of the workings of the universe. There were significant early efforts at mapping the skies, and some important astronomical discoveries and tools developed in the pre-modern era, such as the cyclical nature of eclipses, the size and distance of the moon, and the discovery of galaxies. The early cataloging of stars, as well as accounts of eclipses and other astronomical events, have proved essential records for modern astronomers studying the history of the universe. Modern astronomy begins with the Renaissance-era work of Nicolaus Copernicus and Galileo Galilei, who put forth a heliocentric theory of the solar system—that the sun, not the Earth, is the center of the solar system. After the invention of the telescope, there were no major technological advances for astronomy until the nineteenth century, when the invention of the spectroscope (for measuring light) and photography made it possible to record the size and positions of the stars more accurately. The Astronomical and Astrophysical Society of America (precursor to the American Astronomical Society) was founded in 1899. Modern astronomy's and cosmology's greatest advances have been made in the twentieth century, with observations and theories related to the existence of other galaxies, black holes and other theoretical phenomenon, and the origins, expansion, and age of the universe, including the "Big Bang" theory.

The fourth-century Greek philosopher and mathematician Hypatia is often named as the first female astronomer; she published an *Astronomical Canon*, which was most likely an updated chart of the planets. German-English astronomer Caroline Herschel discovered several comets and compiled a *Catalogue of*

Jocelyn Bell Burnell

British astrophysicist Susan Jocelyn Bell Burnell (b. 1943) made one of the most important discoveries in astrophysics when she identified the first radio pulsars, neutron stars that emit regular pulses of radiation or energy. Her work, conducted while she was still a graduate student at Cambridge, was published in collaboration with her thesis advisor, Anthony Hewish, who was awarded the Nobel Prize in Physics in 1974 for their findings. Bell Burnell's exclusion from the Nobel Prize (which Hewish shared with another colleague, Martin Ryle) has been widely seen as one of the greatest oversights in the award's history. She not only discovered the first pulsars in 1967, but had built the radio telescope necessary for her observations, opening up a new era in astronomical research; hundreds of pulsars would be discovered in subsequent years. She completed her doctorate at Cambridge in 1969 and went on to hold appointments at several universities in the United Kingdom and United States, and has been president of the Royal Astronomical Society and the Institute of Physics. Although she was excluded from the Nobel Prize early in her career, she went on to receive numerous prestigious awards, including the Albert Michelson Medal of the Franklin Institute of Philadelphia (1973, jointly with Hewish), the Beatrice M. Tinsley Prize of the American Astronomical Society (1987), and the Herschel Medal of the Royal Astronomical Society (1989).

Stars in 1798. Maria Mitchell was not only one of the earliest American astronomers, she is considered the first professional female scientist in the United States. Mitchell gained worldwide fame for her discovery of a comet using a telescope in 1847. She became a professor of astronomy at Vassar College, training a new generation of women as astronomers and science teachers, and continues to inspire the work of women astronomers today through the Maria Mitchell Association (<http://www.mmo.org/astronomy.html>).

Beginning in the 1870s and continuing into the early decades of the twentieth century, the Harvard Observatory employed dozens of young women as “computers,” counting and cataloging stars from photographic prints. Although computers were paid low wages for tedious work that was considered “unskilled,” several women made important contributions at Harvard during this era and became prominent astronomers in their own right, including **Annie Jump Cannon**, **Antonia Maury**, and **Henrietta Swan Leavitt**. Before 1920, women astronomers and catalogers did not hold doctorates, but as having a Ph.D. increasingly became a requirement for professional advancement, fewer women made their marks in the field. In 1925, **Cecilia Payne Gaposchkin** was the first woman to receive a doctorate in astronomy from Radcliffe College (Harvard).

Hypatia

Hypatia of Alexandria (ca. 370–415) is considered one of the first women scientists in the Western world. An accomplished mathematician, astronomer, inventor, and philosopher, she was murdered by the Christians then coming to power and seeking to limit the influence of “heretics.” Hypatia was the daughter of renowned mathematician and astronomer Theon, and received a formal education in Athens and Italy. She returned to Alexandria to lecture on Plato and Aristotle and published in several fields, including a 13-volume work on algebra, *Arithmetica*. Her inventions included a hydrometer for measuring the gravity of liquids and an astrolabe for measuring the positions of the sun and stars. Her most well-known work is *The Astronomical Canon*, an updated table or chart of the stars.

Hypatia never married, and it was said that she had “self-possession and ease of manner” and “not unfrequently appeared in public in presence of the magistrates [or of] an assembly of men.” The circumstances of her death, as much as her life and impressive work, sealed Hypatia’s fate as a representative of the persecuted intellectual woman, and she became an important figure in nineteenth- and twentieth-century women’s rights history and in literature. Her contribution to astronomy has been recognized with an asteroid belt and a lunar crater named in her honor.

Observational astronomer **Sarah Lippincott** specialized in identifying the planetlike companions, or extrasolar planets, to nearby stars. Planetary geologist **Lucy-Ann McFadden** keeps an eye on asteroids and dead comets floating near the Earth, and astronomers **Elizabeth Roemer** and **Carolyn Shoemaker** have also contributed to counting and tracking comets. As the twentieth century progressed, women became more involved in theoretical astronomy and astrophysics. **Neta Bahcall**, **Sandra Faber**, **Margaret Geller**, and **Vera Rubin** are all known for their research on the formation of galaxies; Rubin and Bahcall in particular are known for the discovery and study of areas of dark matter in the universe, which are invisible to the naked eye. Other physical scientists study chemical and environmental activity in space. **Margaret Burbidge** collaborated in developing a theory of the origin of chemical elements in the universe; **Nancy Roman** designed satellite observatories for the National Aeronautics and Space Administration (NASA) to explore the universe from a vantage point that is free from atmospheric interference; and solar physicist **Elske v.P. Smith** analyzed active areas, such as flares, on the sun.

Considered one of the physical sciences along with physics and chemistry, astronomy is the smallest of these disciplines, and therefore involves a small number of women employed as professional astronomers and astrophysicists. Because astronomy is not always tracked separately from physics or other departments, it is difficult to determine specific numbers and information on women

Maria Mitchell

Maria Mitchell (1818–1889) is considered the first American woman astronomer and one of the first professional women scientists. She gained international recognition after discovering a comet in 1847 and later became professor and director of the Vassar College observatory. Her interest in astronomy was influenced by her father, who was hired by Nantucket whalers to check the accuracy of their chronometers by means of stellar observation. Maria learned to operate the sextant at an early age and was encouraged to continue her studies of mathematical texts after formal schooling ended. She opened her own school in 1835 and served as librarian at the new Nantucket Atheneum. In 1849, she was hired to work on an annual compilation of astronomical tables for mariners, and began to work for the U.S. Coast Survey.

Although discouraged by the inferior facilities and laboratories made available to women, at Vassar, she was committed to science education, training a generation of young women in observational work and experimentation that became a model at other women's colleges. She was a founder of the Association for the Advancement of Women and was elected the first woman member of the American Academy of Arts and Sciences in 1848 and of the American Association for the Advancement of Science in 1850. Mitchell received several honorary degrees for her astronomical work, and a crater on the moon was named for her.

working in the field. Although the East Coast women's colleges developed strong astronomy programs for undergraduates, there were few women holding Ph.D.s in astronomy through the first half of the twentieth century. One source reports that between 1923 and 1930, women earned 25% of doctorates in astronomy, but that amounted to only 15 individuals, as it was a small field overall. By the 1950s and 1960s, that number dropped to only 10% of doctorates awarded to women (Mack 1990). The American Astronomical Society Committee on the Status of Women in Astronomy conducted a 2003 survey of 40 major research universities and found only 41 women as full professors, compared to 424 male full professors at those same institutions. When all tenure-track ranks are included (assistants, associates, and full professors), there were only 80 female tenure-track faculty spread among 40 universities, compared to 585 male faculty. Several of these universities, even those with large numbers of astronomy faculty overall, reported having only one or two women on the faculty, at any rank (AAS 2003). These numbers are particularly troublesome given that those institutions reported a total of 269 female graduate students enrolled in 2003–2004, and that, in 2003, women earned 46% of all undergraduate degrees in astronomy and 26% of all doctorates (AIP 2005).

The scientists themselves have been active voices for addressing the problems facing women in astronomy and physics. The American Astronomical Society's Committee on the Status of Women in Astronomy provides guidelines and recommendations for institutions and publishes a newsletter, *STATUS*, on women in astronomy and the sciences. In 2005, the AAS endorsed the Pasadena Recommendations for Gender Equality in Astronomy, drafted by the Committee on the Status of Women in Astronomy. The Committee makes recommendations on institutional policy related to tenure, career advancement, and other workplace issues.

See also Physics



Astronomer and geophysicist, Lucy-Ann McFadden. (Courtesy of Mike Morgan, University Publications, University of Maryland)

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Biochemistry

Biochemistry is the study of chemical substances and processes such as metabolism, the functions of enzymes, proteins, carbohydrates, and other molecular and cellular activities in living organisms. It includes biomedical research specialties

such as pharmacology, endocrinology, immunology, genetics, oncology, physiology, cytology, and toxicology. Biochemistry also has applications in plant and agricultural sciences, food and nutrition, earth and space sciences, and crystallography or physics. Although early scientists explored biochemical processes of the body, and of plants and foods, their work would have been considered part of general biological studies, organic chemistry, or what was termed “physiological chemistry.” The term “biochemistry” was not used until the turn of the twentieth century. The *Journal of Biological Chemistry* was founded in 1905 and an American Society of Biological Chemists (now the American Society for Biochemistry and Molecular Biology, or ASBMB, <http://www.asbmb.org>) established in 1906. By the mid-twentieth century, the discovery of DNA brought new research interest to the cell and to genetics, with rapid advances in microbiological and biochemical research in the hopes of finding cures for diseases such as cancer. Biochemistry is still often considered a subfield of chemistry or biology, and not all colleges and universities have a separate program in biochemistry. Thus, biochemists may receive their degrees and training within a variety of other fields and contexts, so that not all those involved in biochemical research may be identified primarily as biochemists.

Because of the broad definition of the field, which overlaps with numerous pursuits in the biological and chemical sciences, women have had a strong presence in the history of biochemistry. When the ASBMB was founded in 1906, it had one female member, a Canadian chemist and food scientist named Clara Benson. Biochemistry was not always tracked as a separate discipline until the mid-twentieth century, and many more women were trained or affiliated with university departments of chemistry (or physiological chemistry in the earlier decades) or general biology. By 1941, however, biochemistry was listed as the most popular subfield for women members of the American Chemical Society. According to one of the earliest breakdowns of biochemistry as a separate subdiscipline, women held close to 12% of Ph.D.s in biochemistry in 1938, and that number remained the same through 1960 (Rossiter 1982, 157; Rossiter 1995, 81). The greatest number of biochemistry Ph.D.s awarded to women before 1940 were from programs at the University of Chicago and Columbia University in New York; several women graduated from the program in microbiology at Johns Hopkins University as well (Rossiter 1982, 184).

The early twentieth-century generation of women biochemists were most likely to be employed in research laboratories or college departments related to food and nutrition, agriculture, and public health, and were involved in the development of key technologies and discoveries in these fields. Their male counterparts were more likely to be employed in medical schools and research universities, while women faculty were more likely to teach at liberal arts colleges (including

the women's colleges) or to hold positions as lecturers (nontenured faculty) or laboratory research assistants. It was also not uncommon for even prominent female researchers to have to wait to be appointed to full professor only at the very end of their careers, just before retirement. This was true for some of the most important female biochemists of the early twentieth century, such as **Florence Seibert**, who developed the much-acclaimed skin test for tuberculosis during the 1930s, but was not appointed a full professor at the University of Pennsylvania until 1955, just before her retirement, and to **Gerty Cori**, who did not attain the rank of full professor at Washington University until after winning the Nobel Prize in 1947. While women were earning 12% of doctorates in biochemistry, as late as 1960 they still made up less

than 5% of biochemistry faculty at the top 20 universities; the percentage of female full professors was under 2% (Rossiter 1995, 129). After 1970, however, women made great strides in this field, and by 2003, women were earning 40% to 45% of higher degrees in biochemistry and molecular biology (Wolfson 2006).

American scientist **Mildred Cohn** was elected the ASBMB's first female president in 1978. The three most recent presidents (between 2002 and 2008) have all been women, and overall the society has had nine female presidents in its now more than 100-year history (besides Cohn, these are: **Mary Jane Osborn**, **Mary Ellen Jones**, **Elizabeth Neufeld**, Susan Taylor, **Judith Klinman**, Betty Sue Siler Masters, Judith Bond, and Heidi Hamm). An unusual number of women scientists working in biochemistry-related research have been recipients of the Nobel Prize in Physiology or Medicine: Gerty Cori, who with Carl Cori elucidated how glycogen is metabolized in the body (1947); **Gertrude Elion**, who with George Hitchings developed the first nucleotide-derived anticancer, antiviral drugs (1988); and **Elizabeth Blackburn** and **Carol Greider**, who shared the prize with Jack Szotack for their collective research on telosomes, providing a new direction in cancer research (2009). The discovery of the gene and of DNA were important



Biochemist Gerty Cori was co-recipient (with her husband, Carl F. Cori) of the Nobel Prize in Physiology or Medicine in 1947. (National Library of Medicine)

breakthroughs in the history of biochemistry and molecular biology. British scientist Rosalind Franklin was central to this research in the 1950s and collaborated with James Watson and Francis Crick, who went on to receive the Nobel Prize for that work. **Maxine Singer** had a central role in articulating standards for work with recombinant DNA. Nobel Prize winners biomedical physicist **Rosalyn Yalow** (1977) and geneticist **Barbara McClintock** (1983) also conducted work in fields that included biochemical studies.

Other prominent women biochemists of the twentieth century have included **Icie Macy-Hoobler**, who established Recommended Dietary Allowances (RDA) for several vitamins and contributed to the understanding of dietary needs of pregnant women, infants, and children, and nutritionist **Gladys Emerson**, who also researched vitamins and helped isolate vitamin E while working at the University of California, Berkeley in the late 1930s. Other biochemists have worked in areas of protein research and disease treatment. **Rachel Brown** and **Elizabeth Hazen** developed the first antifungal drug, nystatin; **Mary Petermann** discovered animal ribosomes, a key to understanding protein synthesis in cells; **Birgit Vennesland** studied carbohydrate metabolism; **Lydia Villa-Komaroff** has researched the role of insulin and other growth factors in brain development; and **Sarah Ratner** also researched protein metabolism and amino acids, and developed a test for identifying the presence of argininosuccinic acid, an indication of a metabolic imbalance that can cause neurological damage. Neurophysiologist **Candace Pert** co-discovered the brain's opiate receptors, which receive chemicals (natural or synthetic) to relieve pain, and co-founded a pharmaceuticals research company to develop a vaccine for the virus that causes HIV/AIDS. Biochemists also conduct research that informs agricultural and environmental science, such as **Mary-Dell Chilton**, a researcher in plant biotechnology and the genetic engineering of agricultural crops to make them resistant to pests and environmental distress, and **Audrey Haschemeyer**, whose research on fish in Antarctica helps us understand how temperature changes affect some of the biochemical processes in humans.

See also **Biology; Biomedical Sciences; Chemistry; Genetics**

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Biology

Biology is the study of life and all living systems, human, animal (zoology), or plant (botany). As the science of the structure, function, development, and evolution of all living organisms, biology is the foundation for, and has applications across, many different scientific disciplines. High-profile subfields of biology include biochemistry, cellular biology, genetics, and molecular biology, but biologists also work in a variety of specialized subfields: evolutionary biology, biophysics, bioengineering, pharmacology, toxicology, environmental biology and ecology, marine biology, and animal sciences (agricultural and veterinary).

Unlike many other disciplines, biology has always had to confront and consider the importance of sex and gender, in the context of the human body as well as in animal and plant life. In the early days of biology as a field of study, scientific knowledge reinforced stereotypical views of male and female social roles. Anatomy, the scientific study of the internal and external structure of the body, was a foundational part of biological and medical sciences, but was subject to social interpretation and therefore "biological determinism"—that is, the attribution of certain human behaviors to biological or "natural" factors. Biological determinism means that biology has provided a scientific basis for eugenics, racial hierarchies, the sexual division of labor, limiting women's education, and the inferior legal and employment status of women and racial minorities. While we no longer accept earlier theories about women's bodies making them incapable of working in scientific or other professions, in the twenty-first century, biology is still a foundational science that informs social policy and attitudes; for example, assumptions about women's bodies still influence medical research and therefore have implications for women's health and healthcare.

By the 1970s and 1980s, feminists began to critique science and scientific language, revealing the gender bias inherent in supposedly objective scientific knowledge. The very foundations of early biology and botany, for example, depended upon classifications made by Carl Linnaeus, who classified "male parts" as *classes* and "female parts" as *orders*, thus establishing a gendered hierarchy into his very classification system, for no specific or legitimate scientific reason. Interestingly, it was also Linnaeus who introduced the term "Mammalia" into biological studies to



Embryologist, Anne Fausto-Sterling.
(Courtesy of Brown University)

define a *class* of humans and other animals, emphasizing the role of breast-milk and lactation over a number of alternative characteristics, such as the presence of hair or live births, rather than a characteristic which applies only to the females of the class. Historian of science Londa Schiebinger has pointed out that Linnaeus made this choice about zoological terminology in the midst of an eighteenth-century social controversy over breast-feeding and wet-nursing, and thus his science was influenced by his own conservative views of women's true "nature" being found in motherhood (Schiebinger 1999, 153–154).

Cultural anthropologist Emily Martin has also analyzed the language of science in earlier cell biology textbooks, which spoke of "the active sperm" and "the passive egg,"

with reproduction presented as a reenactment of human dating rituals rather than an accurate description of the biological process (Martin 1991). Although Martin's critique received quite a bit of publicity, and some scientists responded with new assessments of the "partnership" between sperm and egg, or the more "active" role of the egg, other analysts pointed out the flawed language in considering eggs to be "female" and sperm to be "male" in the first place. The fields of genetics and botany have also had to confront and reconsider the language and metaphors of human gender, sexuality, or marriage as terms and processes used to describe the parts and functions of plants, bacteria, or even DNA (Dudle 2006). Embryologist **Anne Fausto-Sterling** has critiqued scientific discussions of the sex chromosomes (XX for female or XY for male) that refer to the female sex as "lacking" a Y chromosome (or the female embryo as having an "absence" of testosterone), rather than of male chromosomal pairs as "lacking" a second X chromosome (Fausto-Sterling 1992, 77–85). It would be equally problematic to see the female embryo as the standard, or default, and the male as an aberration, but the point is to highlight the social and cultural assumptions that influence scientific perspective and inquiry, and thus scientific results.

Elizabeth Agassiz

Elizabeth Cabot Cary Agassiz (1822–1907) was a naturalist who served as the first president of Radcliffe College between 1894 and 1903. Although she had little formal education, she developed an interest in natural history and assisted in recording the scientific research of her husband, famed Harvard zoologist and geologist Louis Agassiz. In 1865, she accompanied her husband on the Thayer expedition to Brazil to study the fauna, and in 1871, she went on a deep-sea dredging venture, the Hassler Expedition, along the Atlantic and Pacific coasts of the Americas. Her notes on Louis Agassiz's lectures, along with her own notes and observations, were published as *A Journey in Brazil* (1868). She assisted her husband in the planning and management of the co-educational Anderson School of Natural History, which was both a summer school for teacher education and a marine laboratory.

Elizabeth Agassiz also published *Actae, A First Lesson in Natural History* (1859) and, in collaboration with her stepson Alexander, *Seaside Studies in Natural History* (1866). After her husband died in 1873, she compiled a biography, *Louis Agassiz: His Life and Correspondence* (1886). She ran a school for girls in her home in Cambridge, Massachusetts, for many years and in 1879 helped found a Harvard annex for women which became Radcliffe College in 1893, with Elizabeth Agassiz as its first president.

Throughout the nineteenth century, biology was more often referred to or encompassed within “natural history,” which included human as well as animal biology or zoology. Significant numbers of American women have thus been represented in the field since the mid-nineteenth century, and in the twentieth century, biology has become second only to psychology in the numbers of bachelor's degrees awarded to women; biological or life sciences is the single most popular choice for female students in the natural sciences. One explanation given for why so many women scientists choose biology is that women are drawn in greater numbers to the “helping” professions, which includes many specialties within medicine or biomedical research. Within the broad category of biology, however, women and men receive an almost equal number of doctorates; according to the National Science Foundation, in 2006, there were 3,262 Ph.D.s in biological sciences awarded to women, compared to 3,359 awarded to men (NSF Table F-1; NSF Table F-2).

Perhaps because biology is such a broad category, and researchers are more likely to identify according to subfield or specialty, the work of individual women biologists is difficult to extract from the history. Biological research can best be organized around different research objectives. Cellular and molecular biologists

Christiane Nüsslein-Volhard

Christiane Nüsslein-Volhard (b. 1942) is a German developmental biologist who received the Nobel Prize in Physiology or Medicine in 1995 for her work in genetics of the *Drosophila*, or common fruit fly; she shared the prize with American colleagues Eric Wieschaus and Edward B. Lewis. Originally interested in attending medical school, a brief stint as a hospital nurse convinced Nüsslein-Volhard to pursue biological research instead. She received her doctorate in genetics from the University of Tübingen in 1973 and began work on fruit flies, discovering that many aspects of their genetics were similar to, and had implications for research on, other species, including humans. Her research on cellular and embryonic development has been extended to the study of vertebrates, such as the zebrafish. She has been the Director at the Max Planck Institute of Developmental Biology since 1985. Before being recognized for the Nobel Prize in 1995, she was the recipient of numerous other prestigious awards and honors, including the Albert Lasker Medical Research Award, and foreign membership in both the British Royal Society and the U.S. National Academy of Science. Taking her role as a mentor seriously, in 2004, she founded the CNV Foundation to support German women scientists combining work and family.

have contributed to cancer and disease research. **Beatrice Mintz** received her doctorate in zoology in 1946 and was one of the earliest researchers on mammalian genetics and skin cancer; and molecular biologists **Elizabeth Blackburn** and **Carol Greider** received the Nobel Prize in Physiology or Medicine in 2009 for their discovery in the 1980s of the enzyme telomerase and its effect on chromosomes, establishing a new direction in cancer research. Bacteriologists and biochemists have contributed to our understanding of other diseases and to the development of pharmaceuticals and nutrition guidelines. **Lydia Villa-Komaroff's** research led to the development of a specific type of insulin used by diabetics; **Mary Bunting** was a microbiologist trained in agricultural bacteriology, as was **Alice Evans**, one of the earliest women microbiologists (receiving her master's degree in 1910), whose research for the U.S. Department of Agriculture (USDA) on bacteria in cow's milk led to a campaign for pasteurization of all milk; and **Rachel Brown** and **Elizabeth Hazen** were renowned for their discovery of an antifungal antibiotic.

Other biologists have worked as biophysicists and bioengineers, supporting technological advances in aeronautics, robotics, and neuroscience. **Thelma Estrin** pioneered the use of computers in biomedical and neurophysiological research; **Alice Stoll** received her Ph.D. in 1948 and worked with the U.S. Navy studying the physical effects of extreme heat and other forces on the body. Some

women astronauts have been trained in biophysics and medicine as well, such as **Irene Long**, who studied the effect of space flight and weightlessness on blood oxygen and on various health conditions. Biologists working in the fields of genetics and toxicology have studied plants and animals for important discoveries and insights into human health. **Juanita Scott** examined how water pollutants and toxins impact cell growth and development; **Agnes Stroud** studied chromosomes, birth defects, and radiation therapy; **Evelyn Witkin** was trained as a zoologist and studied the genetics of bacteria such as *E. coli.*; **Linda Saif's** work on animal viruses helped the Centers for Disease Control (CDC) create a response to a human outbreak of Severe Acute Respiratory Syndrome (SARS). In all cases, biology is the general foundation of this work in a variety of research fields and inquiries.

See also Biochemistry; Biomedical Sciences; Botany; Genetics; Medicine; Neuroscience; Zoology

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Biomedical Sciences

Biomedical sciences is a broad category that includes research in a variety of disciplines directed to human medical conditions and the underlying biological functions and sources of disease, rather than the clinical treatment of patients by practicing physicians and surgeons. The Biomedical Sciences section of the National Academy of Sciences includes researchers in medical genetics, hematology, oncology, medical physiology and metabolism, immunology, and microbial biology.

Women's roles as caregivers and healthcare providers have put them on the frontlines of early medical and biomedical innovations. In addition to a long history of women's knowledge about herbal medicines and other treatments, women have been central to the development of modern vaccines for a variety of diseases and conditions. Early Taoist nuns (from the tenth and eleventh centuries) may have practiced *variolation* for smallpox, the act of exposing healthy people to a weakened form of the virus in order to build immunity. In 1717, Lady Mary Wortley Montagu of England reported traveling to Turkey and watching "old women" hold smallpox "parties" and "ingrafting" the virus into the skin of healthy people; Montagu introduced the method in England a few years later (Stanley 1995, 155). In the United States, bacteriologists, toxicologists, and pharmacological researchers made great strides in modern vaccine research and development beginning in the 1920s and 1930s. **Gladys Dick** and her husband greatly reduced the incidence and mortality rate of scarlet fever, another longtime killer, with their 1923 discovery of the specific strain of streptococcus that causes the disease. Women researchers developed a skin test for tuberculosis (**Florence Seibert**), antifungal antibiotics (**Elizabeth Hazen** and **Rachel Brown**), and sulfa drugs (**Eleanor Bliss**), and developed transdermal drug patches for motion sickness and other applications (**Jane Shaw**). **Marian Koshland** researched the cholera vaccine, and **Marjorie Horning** researched the effect and transfer of drugs between pregnant women and fetuses. In 1955 **Dolores Shockley** was the first African American woman to receive a doctorate in pharmacology (from Purdue University).

Physiology is the study of the human body and is key to medical research as the foundation of human health and disease. Most physiological researchers work in subfields or specialties based on specific diseases or body systems, such as hematology (blood), endocrinology (hormones), or the respiratory system, to name a few examples. Many researchers have focused on the genetic causes and treatment of specific diseases. **Judith Pool** researched blood coagulation and isolated

a method for treating hemophilia; **Helen Ranney** also focused on genetics and blood diseases, in particular sickle-cell anemia; **Ruth Sager** studied mammalian genetics and tumor suppression in genes; and **Cynthia Kenyon** has focused her work on the aging of cells for insight into age-related diseases.

Some women combine clinical treatment of patients with biomedical research, while others retired from practices as physicians and surgeons to focus on or promote research in a specific area. **Mary Harris** put her background as a physician and researcher of sickle-cell anemia to work as an activist promoting the health and wellness of African Americans; **Maria New** established a research foundation for pediatric endocrinology; and **Christiane Northrup** has been a leading practitioner and voice for women's health and wellness

using traditional and alternative medicines. Many biomedical research findings and advances have been related to or informed cancer research, which is an entire subfield of biomedical research on its own, with geneticists, biochemists, cellular biologists, and molecular biologists leading the way. **Maud Slye** was one of the earliest cancer researchers; **Susan Love** is a former surgeon who created a foundation for breast cancer research and has written numerous books empowering women as patients; and **Elizabeth Blackburn** and **Carol Greider** shared the Nobel Prize in Physiology or Medicine in 2009 for their contribution to cancer research, which has also provided insight into the process of aging.

Several other American women have received the Nobel Prize in Physiology or Medicine for work that has implications for biomedical research. Biochemist **Gerty Cori** (who won the Nobel Prize in 1947) discovered glycogen and its effects on carbohydrate metabolism, providing new insights into diabetes and other diseases; medical physicist **Rosalyn Yalow** (1977) pioneered in the field neuroendocrinology, studying the effect of hormones on health and disease; plant geneticist **Barbara McClintock** (1983) discovered how genes move from one



Physician and women's health advocate, Christiane Northrup, 2007. (AP/Wide World Photos)

Birth-Control Pill (Oral Contraceptives)

Although male scientists were responsible for the development of oral contraceptives (or “the pill”), two women deserve credit for this medical advance that changed women’s lives in the twentieth century and beyond. Nurse Margaret Sanger and philanthropist Katharine Dexter McCormick saw the need for reliable contraception and provided the funding for early research. Sanger, founder of the American Birth Control League, watched numerous women (including her own mother) die from the effects of uncontrolled fertility. McCormick was a suffragist who once smuggled diaphragms from Europe into the United States. After learning of preliminary research on plant-based hormones in the 1930s, McCormick helped fund the work of reproductive scientists in the United States in the 1950s. Although scientists in other countries were also taking up this research, at the time, there was still little interest in pursuing contraceptive research by either the U.S. government or the pharmaceutical industry. These women’s rights reformers, however, saw the potential and the need.

A combined hormone drug was approved by the U.S. Food and Drug Administration (FDA) for menstrual disorders in 1957 and for contraceptive use in 1961. Controversy over the social implications of easy access to birth control began almost immediately. Indeed, the pill played a role in the emerging women’s liberation movement and the rise in women’s labor force participation over the following decades. Both Sanger and McCormick lived into the mid-1960s and thus were able to see birth-control pills become available to a new generation.

chromosome to another, providing a new direction for researchers of human microbiology; neurobiologist **Rita Levi Montalcini** (1986) discovered how rapid cell growth can lead to cancer and other conditions; biochemist **Gertrude Elion** (1988) made advances in research on chemotherapy for treating cancer; and biologist **Linda Buck** (2004) conducts research on the sense of smell.

Another issue within biomedical research besides women’s representation and achievements as professional scientists is women as patients and as subjects of research. Women have been underrepresented in research on heart disease, certain types of cancer, and other conditions, and in research on drug and other treatment options. The widespread exclusion of female patients from medical studies up until at least the 1990s has been due to a variety of factors, including lack of outreach and information provided to doctors and to women patients, assumptions on the part of researchers that some diseases (such as heart disease) impact women less often than men, concern about protecting women of childbearing age, the assumption that women’s hormones will skew a general study, or simply the assumption that women’s bodies are merely a variation on the male standard. Female doctors and

Margaret Sanger

Margaret Higgins Sanger Slee (1879–1966) was the founder of the American birth-control movement in the early twentieth century. She began her career as a public health nurse in New York City's Lower East Side, witnessing the effects of multiple pregnancies, self-induced abortions, and motherhood on the city's poor and working-class women. Sanger's own mother experienced 18 pregnancies and died by age 50. Sanger saw the right to limit fertility as a fundamental right, and she coined the term "birth control" in the pages of her newspaper, *The Woman Rebel*, founded in 1914. She sought to educate women about their own bodies and wrote pamphlets on "Family Limitation," menstruation, and sexuality. She introduced the diaphragm to American women by illegally smuggling the devices from Europe into the United States. Both she and her husband, William Sanger, were arrested for violating the Comstock Law of 1873, which made it illegal to distribute "obscene" materials through the mail. In 1916, Sanger opened the first U.S. birth-control clinic in Brooklyn. Police raided the clinic, and she spent 30 days in jail, forcing the issue to the courts, where a judge ruled to make it legal for doctors to provide family-planning information to women.

Sanger founded the American Birth Control League in 1921 and began an international campaign, working with activists in Japan, Europe, and Africa. In 1952, she became the first president of Planned Parenthood, and she and colleague Katharine McCormick helped fund research for an oral contraceptive pill, which was introduced in 1961.

women's health advocacy groups began bringing this issue to light in the late 1970s and 1980s, and by the early 1990s, the National Institutes of Health (NIH) called for greater representation of women in national clinical trials. Still, a 2009 study published by the American Cancer Society analyzed more than 600 clinical studies on non-sex-specific cancers and found that, although the numbers of women in individual studies varied, on average women made up only 38.8% of the more than 1 million enrolled patients (Jagsi et al. 2009).

Women's very lives are at stake in this research, as women may have different responses to drug therapies than men have. If women are excluded from drug studies that inform doctors' treatment protocols, female patients may be at risk of under- or overdosing, adverse reactions, or missed diagnoses. For example, although heart disease is the leading cause of death for both men and women in the United States, for both biological and social reasons, women are less likely to be screened, diagnosed, or taken to the emergency room for heart issues. Doctors and patients may be more likely to see heart disease as a predominantly male problem and so are slower to diagnose a heart attack in process in a woman. The American

Heart Association launched its “Go Red for Women” campaign to raise public awareness and generate funding for this important issue (<http://www.goredforwomen.org>).

Feminist groups and women’s health advocacy organizations such as the Society for Women’s Health Research (<http://www.womenshealthresearch.org>) have been created not only to influence government and pharmaceutical research priorities, but also to reach out to women and encourage their participation in studies. By the early 1990s, the NIH required female subjects in all government-funded research proposals, and the U.S. government created an Office of Research on Women’s Health (<http://orwh.od.nih.gov/>). Under the direction of **Bernadine Healy**, the first woman to head the NIH (and later president of the American Heart Association), the federal government also launched a multi-million-dollar Women’s Health Initiative to research women’s health issues. These efforts, along with the work of women biomedical researchers themselves, have expanded the notion of women’s health beyond reproductive issues and beyond the childbearing years. New areas of focus include women’s health internationally, especially around issues related to family planning, childbirth, osteoporosis, AIDS, and breast and other cancers that affect women (indeed, despite the important media focus on breast cancer, lung cancer is the leading cause of cancer-related deaths in women).

See also Biochemistry; Biology; Genetics; Medicine; Neuroscience

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Botany

Botany (sometimes called *plant sciences* or *plant biology*) is the scientific study of plants. Plant science includes research on a variety of living organisms, from the simplest bacteria, to algae, fungi, and mosses, to flowers and trees. Botany is

Jane Colden

Jane Colden (1724–1766) is considered the first American woman botanist and is credited with the discovery and naming of a species of gardenia. She was trained by her father, physician and naturalist Cadwallader Colden, who corresponded with the leading scientists of his day, including Carl Linnaeus. Although she never learned Latin, Jane Colden learned to take botanical impressions and to prepare descriptions in English. By 1757, she had prepared a catalog of over 300 local species of flora and had exchanged specimens and seeds with several American and European botanists. As her father's interests turned to other subjects, he planned that she would take over his botanical activities and correspondence. Jane Colden mastered the Linnaean classification system and published a paper in *Essays and Observations, Physical and Literary* of the Edinburgh Philosophical Society in 1770. Her manuscript on New York flora was later deposited in the British Museum, and a portion of it was published in 1963. A review of her work was published in the *Journal of Botany* in 1895. While her drawings are now considered amateur, her descriptions are thought to be thorough and accurate. After she married in 1759, there is no indication that she continued her work in botany.

divided into subfields or specialties not only according to species or kingdom, but by research focus or goals. Plant genetics and cytology informs the human life sciences with a focus on the plants at the cellular level; agronomy is the study of plant crops in agriculture and is concerned with crop development, plant breeding, staple crops, and feed for livestock; biochemical studies on plants support work in human nutrition and pharmaceutical development; ecological botanists study the interactions among plants, animals, humans, and the environment, and inform studies on climate change and habitat destruction; forestry involves the study and management of a variety of plants in the forest ecosystem; marine botany focuses on plant life in the oceans; paleobotany is the study of the plant fossil record; phytopathology is a focus on plant diseases; and horticulturists and gardeners appreciate the aesthetic role of cultivated plants in our lives. The study of plants, then, impacts human life in a variety of ways, as we rely upon plants for oxygen, food, medicine, clothing, materials for other products (such as rubber and wood), fuel, and environmental stability.

Historians of women's contributions to technological development point out that horticulture, agriculture, cloth production, and medicine were seen as women's work throughout early human history, all of which required extensive knowledge of plant life. Women were responsible for gardening, breeding, selecting and experimenting with plants, cooking, and processing cotton, hemp, and other

Almira Phelps

Almira Hart Lincoln Phelps (1793–1884) was a botanist whose popular textbooks influenced science education in the nineteenth century. Her *Familiar Lectures on Botany* (1829) went through numerous editions and sold more than 300,000 copies in the United States and Europe. She was committed to science education and to the education of women, as was her sister, Emma Willard, who founded the Troy Female Seminary in New York. Almira taught in various public schools and academies, including at Troy. She developed her own science curriculum and was the author of popular texts on chemistry, geology, botany, and natural philosophy. Her other works included *Lectures to Young Ladies* (1833), *Chemistry for Beginners* (1834), *Familiar Lectures on Natural Philosophy* (1837), and *Botany for Beginners* (1849). Despite two marriages and a growing family, Phelps taught at schools in several states, including as principal of Patapsco Female Institute in Maryland, a school modeled on the Troy Female Seminary. She was the first female member of the Maryland Academy of Sciences and in 1859 was only the second woman elected to the American Association for the Advancement of Science; the first was astronomer Maria Mitchell.

materials for textiles, leading to specialized knowledge of plants and herbs for food, medicinal, and practical purposes. The first botanists, then, were women, and women were responsible for many early innovations in plant sciences, such as seed separation, chemical fertilizers, and the creation of new hybrid plant species and varieties. In 1796, Priscilla Bell Wakefield published her *Introduction to Botany in a Series of Familiar Letters*, which was reprinted in England and America for the next 50 years. In the United States, Almira Hart Lincoln Phelps published her *Familiar Lectures on Botany* in 1829, an enormously popular book that went through numerous editions.

Even after the late-nineteenth-century professionalization of scientific fields into distinct disciplines, botany was long viewed as an amateur—and therefore female—pursuit. An 1887 article even went so far as to pose the question, “Is Botany a Suitable Study for Young Men?” (Rossiter 1982, 338 n.25). By the turn of the century, many women were able to pursue master’s degrees and doctorates in the sciences, and this generation produced some highly visible and successful female botanists. **Elizabeth Knight Britton** was a graduate of Hunter College and helped found the New York Botanical Society in 1891 and the Sullivant Moss Society in 1898 (later the American Bryological and Lichenological Society, <https://myweb.space.wisc.edu/jpbennet/web/abls/>) (bryology is the study of mosses). In the nineteenth century, Kate Brandegee was the first paid botanical

curator of the California Academy of Sciences; she was succeeded by another woman, **Alice Eastwood**, who did not hold an advanced degree, but who built and oversaw the botanical collection at the California Academy of Sciences for more than 50 years. **Lucy Braun**, who received her Ph.D. from the University of Cincinnati in 1914, was an important botanist, ecologist, and plant cataloger. Jesse Jarue Mark was the first African American to earn a doctorate in botany, which she received from Iowa State University in 1935.

By 1921, the greatest number of female scientists employed in academia were in the field of botany, and the greatest number of these were employed at women's colleges, such as Wellesley, Hunter College, and Smith (Rossiter 1982, 170–173). As in other fields in the natural sciences, such as astronomy or zoology, female botanists created top-notch programs at the women's colleges and had an important role in training the next generation of women scientists. While women were concentrated as students and teachers in a small number of programs in the early part of the twentieth century, their numbers in the field of botany overall were relatively small in the next generation. Between 1946 and 1960, women earned just 11% of Ph.D.s in botany, plant pathology, or plant physiology (Rossiter 1995, 80). Well into the twentieth century, women also predominated as nature illustrators, natural historians, conservationists, and horticulturists working outside of academia. Josephine D. Brownell of Rhode Island patented more than three dozen types of roses between the 1930s and 1950s; Esther G. Fisher patented eight new roses in the 1950s; **Cynthia Westcott** studied rose diseases and wrote several consumer books on garden pests and plant diseases.

Many early women botanists worked in state or local field stations. **Josephine Tilden** traveled the world to study and collect Pacific Rim algae and set up a Canadian research station for the University of Minnesota. Others worked for agricultural corporations and food producers, or for the federal government through the U.S. Department of Agriculture (USDA), a significant employer of early-twentieth-century women scientists, including many botanists. Effie Southworth, a mycologist who focused on fungi, was the first woman plant pathologist employed at the USDA; **Flora Patterson** worked in the USDA's Division of Vegetable Pathology. **Wanda Kirkbride Farr** was an early plant researcher (M.A., 1918) who discovered cellulose and had a career at the USDA, in industry, and in academia.

Because of their early presence in the discipline, women have been especially active in professional plant sciences organizations throughout the twentieth century. In 1929, **Margaret Ferguson** was the first woman president of the Botanical Society of America (BSA, <http://www.botany.org>); **Katherine Esau** studied plant viruses and was president of the BSA in 1951. The BSA has had several more women presidents, including **Mildred Mathias** in 1984; 20 years earlier, in 1964, Mathias was the first female president of the American Society of Plant

Clara Cummings

Clara Eaton Cummings (1855–1906) was an American botanist who specialized in cryptogamic (sporeproducing) flora. She was recognized for her work on the lichens and mosses of Alaska and Labrador, contributing important additions to those classifications and editing publications on North American lichens, liverworts, and mosses. Cummings was educated at Wellesley and at the University of Zurich, although she never obtained a formal degree. She traveled throughout Europe, visiting public gardens and collecting seeds and specimens to send back to Wellesley; she initiated a system of exchanging dried specimens of plants among collectors. She remained associated with the Wellesley botany department throughout her career, first as curator of the botanical museum and then as instructor. In 1903, she was named Hunnewell Professor of Cryptogamic Botany in recognition of the specialized work in which she had reached distinction. She was associate editor of the journal *Plant World*, and she served as vice president in 1904 of the Society for Plant Morphology and Physiology.



Botanist Mildred Mathias. (Used with permission by University of California, Los Angeles)

Taxonomists. Between 1987 and 2007, there were 10 other female presidents of the BSA. **Helen Hart** studied rust-resistant wheat and other crops, and was the first woman president of the American Phytopathological Society (<http://www.apsnet.org>) in 1955. The American Society of Plant Biologists has a section devoted to women in plant biology (<http://www.aspb.org/committees/women/index.cfm>).

Modern botanists have worked in a variety of subfields. **Eloise Gerry** analyzed living trees and forest products; **Estella Leopold** was trained in botany and became a specialist in paleoecology, or the study of prehistoric plant spores and pollen and their environments; **Elisabeth Gantt** researches plant physiology and

process such as photosynthesis; **Jane Rissler** researches the ecological impact of genetically modified food plants; and **Ruth Patrick** studies algae in freshwater ecosystems. Perhaps the most well-known female botanist of the twentieth century is plant geneticist **Barbara McClintock**, who received the Nobel Prize in Physiology or Medicine in 1983 for her work on maize, or corn. The exact numbers of women in plant sciences today is difficult to track precisely because botanists may be trained or employed in programs related to botany, plant sciences, ocean sciences, agriculture, ecology, and general biology.

See also Biology; Environmental Sciences and Ecology; Genetics

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Chemistry

Chemistry is the study of the properties, structure, changes, and reactions of physical matter, but overlaps with and has application to life sciences as well. Chemistry is the foundation of a number of other scientific disciplines, including biochemistry, physiology and pharmacology, geology, metallurgy, physics, and nuclear sciences. It is applicable to a variety of areas that impact our daily lives, including food and nutrition, health and beauty products, medicines, textiles and fabrics, and computers and plastics.

Chemistry has a long history; in some sense, women may be considered the first chemists. Women historically and cross-culturally have been responsible for baking and cooking, the preparation of herbs and other medicines, and even the creation of perfumes, all of which require the use of chemical and biochemical processes and reactions. Women were recorded as early alchemists as well (alchemy combined chemistry and philosophy or magic in efforts to transform common materials into valuable ones, such as gold or anti-aging cures) among the ancient Chinese and Egyptians, and—in even greater numbers—during the European medieval and Renaissance eras. During the “chemical revolution” of the eighteenth century (which saw the discovery of the properties of gases and of oxygen, among other milestones), several women worked as assistants or were spouses of prominent scientists. Unlike the greater number of women who worked as amateur astronomers, naturalists, geologists, or social scientists, chemistry required access to laboratories and equipment, and some wealthy or well-connected women were able to fund private research. A few European women emerged as voices in early chemistry: Englishwoman Jane Marcet published her *Conversations on Chemistry* in 1769 (read by physicist and electricity experimenter

Michael Faraday), and Scottish chemist Elizabeth Fulhame published *An Essay on Combustion* in 1794. Through the eighteenth and nineteenth centuries, chemistry was not necessarily a separate discipline, but overlapped with work in (and was often overshadowed by) physics and mathematics.

By the end of the nineteenth century, the scientific disciplines were professionalized, and status as a scientist depended on higher education and access to university laboratories, both of which were slow to admit women. In the United States, Helen Abbott Michael briefly attended Women’s Medical College in Philadelphia but became interested in plant chemistry and was the first woman invited to lecture at the Philadelphia College of Pharmacology. She later worked in the laboratory of her



Chemist Emma Perry Carr. (Bettmann/Corbis)

Dorothy Crowfoot Hodgkin

British chemist Dorothy Crowfoot Hodgkin (1910–1994) advanced the field of crystallography and won the Nobel Prize in Chemistry in 1964 for her discovery of the molecular structure of penicillin and vitamin B₁₂. She later determined the structure of insulin as well. Hodgkin was born in Egypt and educated at Somerville College, a women's college at the University of Oxford, England, and at Cambridge. Even after receiving her Ph.D. in 1937, she was prevented from attending regular faculty meetings at Oxford or from using the equipment in male faculty's laboratories. She raised her own money and received several prestigious grants to purchase X-ray equipment with which to take photographs of proteins, cholesterol, antibiotics, vitamins, and other biological molecules. She was not named a full professor until 1958, after 20 years of research at Oxford. By that time, she was one of the founding members of the International Union of Crystallography and had been named a fellow of the Royal Society, the highest scientific honor in Britain, for her work on the structure of penicillin. When, in 1964, she became the third woman to receive the Nobel Prize in Chemistry, the newspapers reported that a "housewife" and "grandmother" had won the prize.

husband, a chemistry professor at Tufts University. The periodic table of elements was created in the nineteenth century, with new elements and synthetic elements later discovered, and the American Chemical Society (ACS) was founded in 1876, with Rachel Bodley admitted as the first female member. Bodley subsequently resigned her affiliation with the ACS over antiwoman commentary and activities at the annual meeting. Rachel Lloyd, a chemistry professor at the University of Nebraska who received her doctorate in Switzerland, was the next woman to join the ACS, in 1891. Food chemist Ellen Swallow Richards was the first female student and the first woman instructor at the Massachusetts Institute of Technology (MIT), where she taught industrial chemistry and other courses (without pay) beginning in 1879. **Emma Perry Carr** was one of the earliest American women to receive a Ph.D. in chemistry (University of Chicago, 1910), and in 1937 was the first woman to receive the Garvan Medal of the American Chemical Society, a prize to acknowledge women's contributions to the field. She taught chemistry for four decades at Mount Holyoke.

Inspired by the discovery of X-rays in 1895, scientists began searching for other sources of radiation and analyzing the radioactivity of various elements. The structure and theory of atoms and molecules was explained in the 1920s and 1930s, and some of the most important discoveries of the twentieth century relied upon this overlap between chemistry and physics. The work of one of the most distinguished

Irène Joliot-Curie

The Curie family was one of incredible achievements: French chemist and nuclear physicist Irène Joliot-Curie (1897–1956), daughter of Nobel Prize winners Pierre and Marie Curie, also received a Nobel Prize in Chemistry in 1935, jointly received with her husband, Frederic Joliot, for their work on radioactivity. Irène Curie worked with her famous mother on administering radiography and radium treatment to soldiers during World War I. She went on to earn a doctorate in 1925 with a thesis on polonium, an element discovered by her parents. Joliot-Curie's research on radium led to the Nobel Prize and paved the way for the discovery of nuclear fission by other scientists. She was a Commissioner for Atomic Energy in France and in 1946 became director of the Radium Institute founded 30 years earlier by her parents. Like her mother before her, Joliot-Curie's long-term work with radioactive elements, including an accidental exposure to polonium, led to the development of leukemia and an early death. The family scientific legacy continues, as both of Joliot-Curie's children are physical scientists in France: daughter Hélène Langevin-Joliot is a nuclear physicist and son Pierre Joliot is a biochemist.

women in chemistry reveals this overlap. French scientist Marie Curie discovered that thorium was radioactive and was awarded the Nobel Prize in two different fields—she shared the Nobel Prize in Physics in 1903 and won the prize in Chemistry in 1911. Her daughter, Irène Joliot-Curie, amazingly, also won a joint Nobel Prize in Chemistry in 1935 for her work on radioactive elements. Both women died of leukemia, undoubtedly from radiation exposure in the course of their scientific work. Two other women have won Nobel Prizes in Chemistry for their work using X-ray crystallography: British scientist Dorothy Crowfoot Hodgkin won in 1964 for studying the structures of biochemical substances, and Israeli scientist Ada Yonath shared the prize in 2009 for her research on the role of ribosomes in DNA.

Chemistry as a research field and method overlaps with numerous other scientific disciplines, and so the true numbers of women engaged in chemical research is extensive and unknowable. Early-twentieth-century women chemists worked in agricultural and food sciences, nutrition, biochemistry, industrial chemistry, and pharmaceuticals development. **Anna Sommer** was an early plant or soil chemist who received her doctorate from Berkeley in 1924 and identified minerals in soil and their benefits for agriculture. Biochemistry was another “new” science of the early twentieth century and involved understanding the chemical processes of cells, enzymes, proteins, and the effect of organic and synthetic substances on the body,

and American women have made substantial contributions in this field. **Marie Daly** was the first African American woman to earn a Ph.D. in chemistry (from Columbia University in 1948) and was one of the early biochemists who discovered the link between cholesterol and heart attacks. **Elizabeth Weisburger** is a toxicologist researching the carcinogenic (or cancer-causing) effects of chemicals in environmental toxins and even in medicines. In the late twentieth and into the twenty-first centuries, some of the most important work in chemistry is still being done in pharmaceuticals and biochemistry research, with the addition of the fields of nuclear science and physics, plastics and material sciences, and, of course, computers (semiconductors, silicon chips). Chemists have received an extraordinary large number of patents due to the nature of the field as one of innovation and discovery. **Stephanie Kwolek**, a chemist for DuPont, invented Kevlar, a high-strength material used in a variety of products, including bulletproof vests for law-enforcement officers and for soldiers. Textile chemist **Ruth Benerito** received more than 50 patents for processes related to treating fabrics and permanent-press materials. Women chemists are proud of their long history of achievement and contributions, and maintain records of that history through organizations such as the Chemical Heritage Foundation's Women in Chemistry project (http://chemheritage.org/women_chemistry/).

The numbers of women as chemistry students in colleges and universities peaked (as it did in the sciences overall) in the 1920s. In 1929, women received 10% of all U.S. chemistry doctorates; that number decreased to just 5% of doctorates in 1933, and reached an all-time low of 2% throughout most of the 1940s (Rayner-Canham and Rayner-Canham 1998, 199). But while women were not earning doctorates at a high rate throughout the 1940s, more women than ever were employed, including as new faculty members. Chemistry was one of the fields that saw a tremendous increase in the numbers of women due to technological development and needs during World War II. During just the four-year period between 1942 and 1946, the numbers of women chemistry faculty members in universities more than tripled (Rossiter 1995, 11). The numbers of women going to graduate school and earning doctorates, however, would not rise again until the 1970s, at which time women reached 10% of chemistry Ph.D.s again, and have risen steadily ever since. In 1985, women earned 20% of chemistry Ph.D.s, but made up only 4.9% of tenure-track faculty. Significant progress in women's access to higher education resulted in women earning 30% of chemistry doctorates by 2003, but they still make up only 12% of tenure-track faculty, revealing a "leaky pipeline" in academia seen throughout the sciences (Wilson 2006). Many chemists, however, work outside of academia in industrial or government research or pharmaceutical companies.

See also Biochemistry; Crystallography; Nutrition

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Climatology

See Meteorology

Computer Sciences and Information Technology

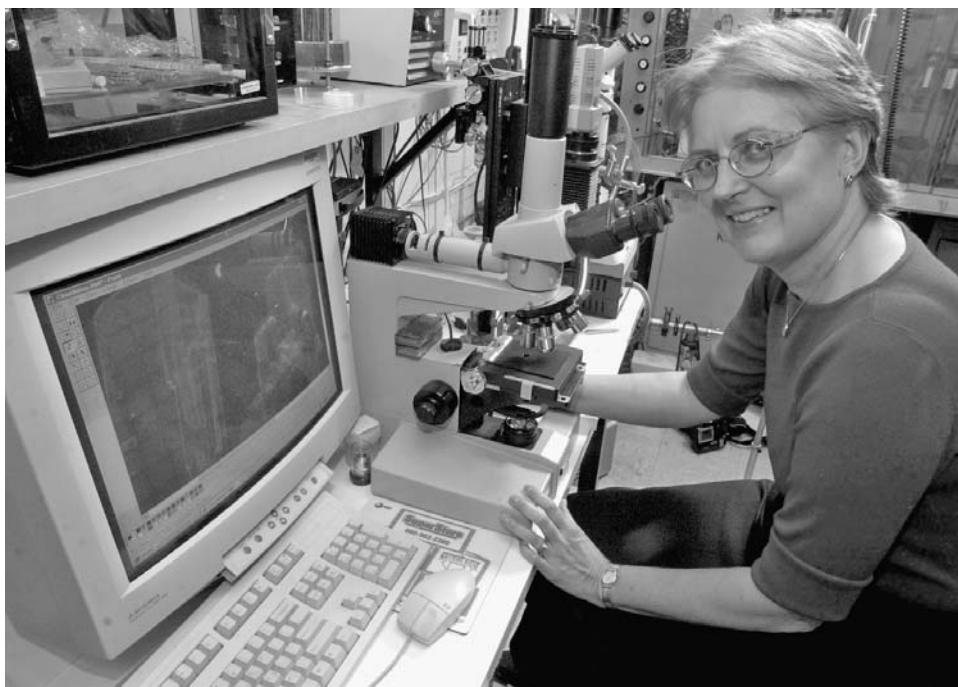
Computer science encompasses both the theory and application of automation and information processing, from creating mathematical algorithms and programming languages to the design and implementation of user-friendly software and hardware. It may also include a broad range of activities related to information technology (IT), which deals with the storage, retrieval, and transmission of information through databases and networks. Computer sciences is one area in which technical experience and knowledge are essential; therefore, gainful employment, even at the highest levels, may be attained without a doctorate, although the Ph.D. is usually required for university teaching and research positions. Many computer scientists and software engineers are employed in industry or business, and many others are self-employed in the technology sector. This explains, in part, the discrepancy between the relatively low number of women receiving doctorates in computer sciences and the high number of women actually employed as computer and information scientists. The doctorate in computer science is itself a fairly recent development. In 1968, **Barbara Liskov** became the first woman to earn a Ph.D. in a computer science program. Nearly 40 years later, in 2006, only 310 computer science Ph.D.s were granted to women, or 2.7% of all science and engineering doctorates earned by women (NSF Table F-2), and yet women accounted for 39% of computer and information scientists, the single largest occupational category for women scientists and engineers in 2006 (NSF Table H-19).

Ada Lovelace

Augusta Ada Byron King, Countess of Lovelace (1815–1852), is recognized as one of the pioneers of computer programming for her detailed notes on the invention of a nineteenth-century calculating machine. Born in London, she was the daughter of Romantic poet Lord Byron. She never knew her famous father, however, who separated from her mother, Anne Isabella Milbank (Lady Byron), and left England just a few months after Ada's birth. In 1835, Ada married William King, Earl of Lovelace. Although there were no scientific or professional opportunities for a woman at that time, as a member of the elite, she received a solid education and was able to pursue an intellectual life. She befriended Cambridge mathematics professor Charles Babbage, who invented several calculators and had Ada compile and translate notes on his plans for an "analytical engine." He never built the machine, but Ada's notes reveal the earliest algorithm for machine calculations, the precursor to the modern computer. She has been the subject of several biographies, credited for her role in early mathematics and computing. In the 1970s, the U.S. Department of Defense's computer programming language, Ada, was named for her.

The history of computing, however, is much longer and overlaps with innovation in mathematics and technology. Women made early contributions to computing, beginning with Ada Lovelace (born Augusta Ada Byron), who co-invented a proto-computer adding machine or calculator in the nineteenth century. Her role was later acknowledged with an early programming language for the military that was named "Ada." Before the invention of electronic computers, "computer" was a job description, not a machine. Both men and women were employed as computers in the early twentieth century, but women were more prominent in the field due to the wartime shortage of male workers. In 1942, just after the United States entered World War II, hundreds of women, many with degrees in mathematics, were employed in government research centers and universities as computers, using mechanical desk calculators to solve long equations. The results of these calculations were compiled into tables and published for use on the battlefield. The tables allowed soldiers in the field to aim artillery or other weapons, taking into account variable conditions such as temperature and air density. Today, such calculations are done instantly with microcomputers. The computer itself (as we know it) was developed after World War II, also for government and military applications. ENIAC was one of the first electronic digital computers, and Adele Goldstine, a former math teacher, trained the first group of women programmers. At that time, programming involved manually assembling the circuits and cables, and Goldstine wrote the technical operator's manual for ENIAC (Stanley 1995, 442–443).

During the Cold War and the years of the space program, smaller, faster machines were developed that outperformed the large government mainframes, and software applications were developed that could be marketed to the general public. Computers were soon used for everything from engineering and design work, to games and animation used by the entertainment industry, to everyday office use. Women were important to the development of early computer hardware systems, including **Margaret Butler**, who helped develop one of the first digital computers for science as a staff mathematician at Argonne National Laboratory in the early 1950s. **Grace Hopper** (also a mathematician) was part of the group that developed COBOL, the most widespread programming language through the 1960s and 1970s. **Evelyn Berezin** is often called the “mother of word processing,” and she founded her own company in 1969 to manufacture and sell a machine that would replace the editing typewriter. By the 1980s, word processors were basic equipment in every office, and word-processing software soon became a standard feature of every personal computer. **Lynn Conway** is known for designing and fabricating integrated computer circuit chips, and **Elsa Reichmanis** helped develop new materials that are used in integrated circuits.



Computer scientist and organic chemist, Elsa Reichmanis, 2002. (AP/Wide World Photos)

Other women have been involved in the development of computer software. **Adele Goldberg** helped develop a programming language for a personal computer while working for Xerox Corporation. Her “object-oriented” program included icons, windows, and a mouse, all user-friendly features that became the foundations of the Microsoft and Apple consumer software programs ubiquitous today. **Martine Kempf** and **Sandra Hutchins** worked on voice-recognition software; **Sandra Kurtzig** founded her own software company, ASK Computer Systems, which became one of the largest public companies founded by a woman. **Ruth Davis** helped establish international standards for data encryption of computers, and **Thelma Estrin** and **Evangelia Micheli-Tzanakou** researched computer applications in brain research. Mary Pickett was involved in programming industrial robots for use in manufacturing at General Motors Corporation in 1984, making it possible to automate an entire production line. **Jean Sammet** was in charge of programming languages at International Business Machines Corporation (IBM) for many years and taught some of the first college computer programming languages in the United States in the 1950s. Sammet was also the first woman president of the Association of Computing Machinery (ACM), and Adele Goldberg and **Gwen Bell** have been presidents as well. **Mary Shaw** helped establish software engineering as a profession, and **Roberta Williams** was one of the pioneers of the computer gaming industry, one of the biggest growth areas in software for the twenty-first century. In 2006, Frances Allen became the first woman to receive the Turing Award, considered the Nobel Prize of the computer industry, for her innovations in high-speed computing.

Other scientists have been concerned with the social impact of computers. Psychologist **Sherry Turkle** is an authority on the psychological and sociological effects of computers, and has researched how individuals interact with computers and how computers shape our identities. Some feminists have been interested in the role of gender in computer experiences, finding the profession as well as consumer access to be male-dominated enterprises. The Internet era has created a “global village,” not only connecting the world, but changing the home-versus-work dichotomy and therefore impacting women’s lives. Computers have had a revolutionary impact on women’s roles as workers and as consumers, creating new possibilities for wage-earning and for work/life balance through telecommuting, online sales, microbusiness, and distance education and skills acquisition. All of these innovations have potential for increasing women’s economic independence, but also raise questions about how, even as we are connected to the larger world, the Internet confines women’s work more securely within the home, as there is no longer a need to leave home to pursue education and employment.

While access to the Internet has created a global “information revolution,” some scholars argue that there is still a “digital divide” when it comes to gendered

and economic access to computers and the Internet. Issues of education, household resources, job skills, and even access to electricity affect different regions of the world unequally, and may also be gendered in ways that impact women's ability and rate of online access. Another issue for feminists concerned about women's access to technology and technology-related careers is the computer literacy and education of girls. Early education is key in creating interest and skills for later success, as early computer literacy has been linked to higher math test scores and later interest in science and technology fields. Early computer education may not be gender-neutral, however, as some studies have found that boys are more likely to receive computer education at home from their parents, are more likely to have computers in their own rooms, and spend more time playing handheld and computer gaming systems, all activities that increase early computer literacy and may disadvantage girls (Margolis and Fisher 2003). While the technology itself may be gender-neutral, the change brought by technology has the potential for either challenging or upholding existing social beliefs and roles.

See also Engineering; Mathematics

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Crystallography

Crystallography is the science of determining the physical structure of atoms or molecules in crystals or other solid matter, such as minerals, metals, vitamins, coal, salts, proteins, viruses, cells, and DNA. It is a subfield of physics or chemistry and has applications for research in other areas as well, notably biology, biochemistry, and geology or earth sciences, and also requires the use of mathematical models and analyses. Understanding the structure of crystals informs our understanding of the properties of a variety of materials, and therefore has implications for research not only into organic matter, but related to the development of synthetic chemicals, plastics, metals, and other materials as well. A career in crystallography can be approached from several different disciplines, including chemistry, physics, biology, geology, mathematics, and materials science. The best preparation is a broad background in several scientific areas, as well as experience using and programming computers. A bachelor's degree in biology, for example, should include more physics, mathematics, and chemistry than normally required.

Crystallography is a new science of the twentieth century. There were early efforts to determine and record the structure of crystals using microscopes, but in the early 1900s, it was discovered that X-ray waves could be used to diffract or reflect the image of a crystal, revealing the internal patterns and structures. The technological advances of tools of X-ray crystallography, including the spectrometer and spectrophotography, made it possible to record and analyze an unlimited number of molecules from a variety of materials. After the first efforts of X-ray crystallographers to examine the structure of minerals and elements, there was an explosion of interest in the following decades in determining the structure of other molecules from organic materials. There was suddenly an unlimited amount of work to be done, and so many women entered the field that, for a time in the early to mid-twentieth century at least, crystallography was seen by many scientists to be a predominantly female field. This was probably due, in part, to the fact that, as a new field of study undergoing rapid technological and knowledge advances, crystallography did not have an established hierarchy. It was an ideal entry point for younger scientists, many of them women among the first generation earning advanced degrees in science, to break into scientific research and have an opportunity to excel.

Ada Yonath

Israeli scientist Ada Yonath (b. 1939) was awarded the 2009 Nobel Prize in Chemistry for her work on the structure of bacterial ribosomes. She uses crystallography, or X-ray techniques, to understand the effect of antibiotics on bacteria, aiding research on antibiotic resistance and the development of new drugs. She is professor of structural biology and current director of the Helen and Milton A. Kimmelman Center for Biomolecular Structure and Assembly at the Weizmann Institute of Science in Rehovot, Israel. Although her Jewish parents were not wealthy, she was able to attend the Hebrew University of Jerusalem, where she studied chemistry and biochemistry, and went on to earn a doctorate in crystallography from the Weizmann Institute. She has conducted research and held prestigious appointments at universities in the United States, Germany, and Israel. In 2003, she was named as a foreign associate to the U.S. National Academy of Sciences. She shared the 2009 Nobel Prize with British researcher Venkatraman Ramakrishnan and American Thomas A. Steitz, and is the first Israeli woman to receive a Nobel Prize.

Crystallography was also an international effort, and British women subsequently made some of the most important and high-profile discoveries in the field. Rosalind Franklin created and analyzed X-ray images of DNA, the tobacco mosaic virus, and the polio virus. Her work led to the discovery of the double-helix structure of DNA, for which her contemporaries, Francis Crick and James Watson, were awarded the Nobel Prize in Physiology or Medicine in 1962. In one of the more tragic stories in the history of women in science, Franklin died at the age of only 37 after developing ovarian cancer (which many believe was due to her exposure to X-ray radiation in her work) and, as the award is not granted posthumously, was left out of the Nobel Prize recognition. Another British scientist, Dorothy Crowfoot Hodgkin, won the 1964 Nobel Prize in Chemistry for her use of X-ray crystallography to determine the structure of vitamin B₁₂. Hodgkin also confirmed the structure of penicillin and insulin, and therefore her work had implications for biochemistry and pharmaceutical development. Another woman, Israeli scientist Ada Yonath, shared the Nobel Prize in Chemistry in 2009 for her use of X-ray crystallography in research on the role of ribosomes in DNA.

While British women were overwhelmingly represented in crystallography in the first half of the twentieth century (Rayner-Canham and Rayner-Canham 1998), the first woman to earn a Ph.D. specifically in crystallography was **Gabrielle Donnay** at the Massachusetts Institute of Technology (MIT) in 1949, who worked in the field of geology and mineralogy. American **Isabella Karle** and her husband, Jerome Karle (also a Nobel Prize recipient), had an amazing 60-year career as

Rosalind Franklin

British geneticist and crystallographer Rosalind Franklin (1920–1958) was part of the team that discovered the double-helix structure of DNA, one of the greatest scientific discoveries of the twentieth century. For many years, however, Franklin's contribution to this work was unacknowledged by either her colleagues or the larger scientific community. Franklin graduated from Newnham College, the women's college of Cambridge University, and her early work in chemistry and crystallography focused on determining the structure of coal and carbon. After receiving her doctorate from Cambridge, she began using X-ray diffraction to take numerous pictures of DNA in order to create a model of its structure. American James Watson was also researching DNA models, and Franklin's photos provided the evidence for his theory of the double-helix structure of the DNA molecule. In April 1953, Watson and Francis Crick published their famous results in the British science journal *Nature*, which also contained a supplemental article by Franklin and a student, Raymond Gosling, providing evidence from their own research. Franklin went on to study the structure of other biological substances, including the polio virus. Unfortunately, she died of ovarian cancer in 1958 at the age of only 37, and Watson, Crick, and Maurice Wilkins earned credit for the DNA discovery with a Nobel Prize in Physiology or Medicine in 1962 (the prize is awarded only to living scientists).

renowned crystallographers with the Naval Research Laboratory. The Karles made technological advances in the field with their invention of a new method for photographing crystals, and Isabella Karle's work provided the foundation for development of synthetic materials, including pharmaceuticals. **Elizabeth Armstrong Wood** used crystallography in her work in geology, studying minerals and rocks, and later in the development of lasers and other work for Bell Telephone Laboratories. Both Elizabeth Wood and Isabella Karle served as presidents of the American Crystallographic Association, in 1957 and 1976, respectively.

Other women working in biomedical sciences or physics have studied or used crystallography, including **Jane Richardson** and **Dorothy Maud Wrinch**, biochemists who map proteins, and **Jenny Glusker** (who studied with Dorothy Hodgkin in Oxford, England), who has contributed to cancer research with her work using crystallography to determine the structure of cancer-causing chemicals, or carcinogens. Physicist and metallurgist **Julia Weertman** studies the structure and temperature resistance of different metals, and nuclear physicist **Chien-Shiung Wu** separated uranium isotopes and helped develop radiation detectors as part of the atomic bomb project in the 1950s.

It is difficult to determine the exact number of working crystallographers because of the interdisciplinary nature of the field and because crystallography is



Crystallographer and cancer researcher, Jenny Glusker. (Courtesy of the Fox Chase Cancer Center.)

not only a subfield but more of a focus or tool used within these other disciplines. The American Crystallographic Association (<http://aca.hwi.buffalo.edu/>) and the International Union of Crystallography (<http://www.iucr.org/>) bring together and represent scientists working in various fields.

See also Biomedical Sciences; Chemistry; Geology; Physics

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Earth Sciences

See Environmental Sciences and Ecology; Geography; Geology; Meteorology; Ocean Sciences

Economics

Economics is defined by the *Merriam-Webster* dictionary as the "social science concerned chiefly with description and analysis of the production, distribution, and consumption of goods and service." The analysis of property, wealth, and markets has a long history, and has impacted the development of ethics, law, trade, and politics as well. Economists work in a variety of subfields and study not only

financial information and trends but human behavior as well in seeking to understand our relationships to and decision-making processes about work, money, and consumer goods. *Laissez-faire* economics focuses on individual rational economic choices as driving the supply and demand of markets, while more radical theories (influenced by Karl Marx in the nineteenth century) argue that individuals have little choice within capitalism, which depends upon a permanent wage-earning class. Beginning in the 1970s, feminists pointed out the connection between patriarchy and capitalism, both of which rely upon women's unpaid household labor to uphold the economy. Finally, an institutional model of economics takes a broader view of how multiple economic, political, and cultural systems (such as religion) work together to impact the economy of a specific region or society.

Much of Western thinking about economics has been influenced by Adam Smith's theory of the free market in *The Wealth of Nations*, first published in 1776. Priscilla Bell Wakefield made the earliest female response to Smith's text, arguing in her 1798 essay, "Reflections on the Present Condition of the Female Sex, with Suggestions for Its Improvement," that the economic contribution of women in the home, and the exchange of services and not just goods, is also essential to the economy. Throughout the nineteenth century, feminists linked women's economic dependence on men, and their underlying lack of access to education and the professions, to female legal and political subordination. One hundred years after Wakefield first challenged Smith's economic model, American writer Charlotte Perkins Gilman published *Women and Economics: A Study of the Economic Relation between Men and Women as a Factor in Social Evolution*, a radical call for women's economic independence and a challenge to the dependence forced upon women through marriage and motherhood.

The field of economics itself has been understood by many feminists to be male-dominated in both employment patterns and subject matter. Only a handful of female economists have been elected to the National Academy of Sciences, including **Anne Krueger** (1995), **Nancy Stokey** (2004), and **Elinor Ostrom** (2001). The American Economic Association (AEA) Committee on the Status of Women in the Economics Profession (<http://www.cswep.org>) tracks the numbers and employment status of female economists at research universities. In 2007, women received nearly 35% of new doctorates in economics and subsequently made up 28.8% of entry-level tenure-track professors; this is compared to 1972, when women earned 12% of economics doctorates and made up only 6% of full-time faculty of any rank. However, at the highest levels of academia, in 2007, women made up only 8.7% of full professors. Even more discouraging, some 40% of Ph.D.-granting research institutions had no female full professors on the faculty in 2007.



Economist Anne Krueger served as a vice president and consultant for the World Bank and director of the International Monetary Fund from 2001 to 2006. (AP/Wide World Photos)

As in computer sciences and engineering, however, there are many high-level career opportunities outside of academia, and economists are employed in diverse research, government, policymaking, national, and international business settings. In 2008, a full one-quarter of employed female economists in the United States worked in the private sector, and another 10% were employed in the government or public sector. Another 20% were employed internationally, either in foreign universities or in business (Fraumeni 2008). **Juanita Kreps** and **Alice Rivlin** have held prominent positions within the U.S. government. Kreps served as the first female (and first professional economist) Secretary of Commerce, serving under President Carter, and Rivlin has held several government positions, includ-

ing as first head of the Congressional Banking Office when it was established in 1975 and later as vice chair of the Federal Reserve Board. Other economists have worked in both academia and government; **Laura Tyson** has held a long-time faculty position, has been dean of two prestigious business schools, and has also served as economic advisor to two presidents on global markets, trade, high-tech industries, and healthcare reform. Economics was added as a category for the Nobel Prize in 1969, and 40 years later, in 2009, American **Elinor Ostrom** became the first woman to receive that prize.

Some universities now offer specialization or certification in gender and economics. Feminist economic theory begins with a critique of theories that focus solely on the public spheres of markets and production (wage work), ignoring the economic contribution of women's unpaid work of household labor, reproductive labor, and their role in consumption. The rise of the new home economics in the 1980s sought to make women's work visible and quantifiable, while acknowledging that household labor and childcare also limit women's choices regarding participation in wage work. This, in turn, justifies paying women less because they are seen as temporary, part-time, or uncommitted workers. The feminist critique of

rational individual economic behavior, then, questions how much economic “choice” women can truly exercise when considering the options of either working for low wages in “women’s” jobs or working without pay in the household.

Other workplace issues affecting women’s economic status include equal pay, educational and employment access, hiring and advancement discrimination, and welfare issues. **Phyllis Ann Wallace** was the first black woman to receive a doctorate in economics from Yale University (1948), and was a pioneer in research on the economics of racial and sexual discrimination in the workplace. A significant amount of recent attention has also been focused on the relationship between work and parenting, whether on the work mothers perform in the home, the challenges for working mothers in the wage labor force (including access to affordable, quality childcare), or women’s “second shift” of work and childcare at home. **Sylvia Hewlett** founded the Center for Work-Life Policy (<http://www.worklifepolicy.org>) to research precisely these and other dilemmas facing women in the workforce throughout the lifecycle, as the sexual division of labor disadvantages women not only during childbearing and childrearing years, but in old age as well.

Finally, it is not only workplace issues, or questions of education and access, but also gender inequality in the family itself that limits women’s economic activities and potential. Feminists question the ability of women to make free individual economic “choices” given the limits and pressures of family, culture, religion, and governments (particularly development programs) on women’s lives. In this sense, economic relations and contexts may be more important than a focus solely on individual choices and needs. For example, self-interest (survival) is often seen as driving economic choices, but self-interest may look different for women compared to men. Women may not always operate from a perspective of self-interest or competition, or from a perspective of maximizing wage-earning as their primary economic role. Women, in general, some economists have shown, are more likely to make economic decisions based in a larger family context of caregiving and providing for the education and future security of children.

See also Nutrition and Home Economics

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Engineering

Engineering can be defined as the practical application of mathematical and scientific principles to challenges in design, manufacturing, and operation. Engineers may design materials, structures, machines, computer programs, concepts, or processes. There are many different types of engineers, such as civil, electrical, mechanical, chemical, safety, materials, industrial, computer, aeronautical, aerospace, and biomedical. Broadly considered, then, engineering is the foundation of technological development and innovation across many scientific fields or disciplines and therefore overlaps with the history of science in general. Humans have always sought to understand and improve their lives through the invention of tools, machines, buildings, cities, aqueducts, military equipment, household appliances, bridges, electricity, different modes of transportation and communication, foods, pharmaceuticals, chemicals, plastics, and computers. Different branches of engineering, or specialties, formed around specific industries and needs, but as all engineers seek to understand how things work, they must therefore have a strong foundation in the physical and theoretical sciences and in mathematics.

Women have a long history of engineering contributions, although those contributions have not always been acknowledged or recorded. The first American woman to receive a patent was probably Mary Dixon Kies of Connecticut, who in 1809 patented a process for weaving straw with silk or thread (Stanley 1995, 304). Engineering has not always been considered a separate field, and many early engineers (as we would identify them today) were trained and worked within physics, chemistry, math, or other fields, even business, psychology, or home economics (as with **Lillian Gilbreth**, an industrial time-management engineer who was the first female member of the Society of Mechanical Engineers). There have been an overwhelming number of women's inventions, tools, machines, and electrical or mechanical processes, some patented, some developed without acknowledgement or recompense to the original inventor. The first American doctorate in engineering was awarded at Yale University in 1863, and by the early 1900s, only a few women had earned formal engineering degrees. Olive Dennis received a degree in civil engineering from Cornell University in 1920 and worked for many years as a "draftsman" designing railroad terminals. Commenting on the small but visible presence of women in engineering programs, a 1937 school newspaper reported, "Three Coeds Invade Engineering Courses and Compete with Men at Cornell University: Stand Well in Their Studies" (Bix 2006, 47). The headline acknowledged the women's accomplishments,

but the use of words such as “invade” and “compete” reflected the view that the women’s presence was still a hostile act.

Still, Cornell was among the few schools admitting women as engineering students before World War II. The Massachusetts Institute of Technology (MIT) admitted a few women, including **Edith Clarke**, the first woman to receive an electrical engineering degree from MIT in 1919. Clarke went on to have a productive career in both industry, working for ATT and General Electric, and later in academia. But some of the most prestigious engineering programs and technical schools did not admit any women until well into the 1950s and 1960s. As in many other scientific fields, it was the shortage of male workers during World War II, and the new technological demands of war, that opened doors for women, especially in new industries and nontraditional work for women. Companies recruited women and trained them on the job in mathematics, basic scientific concepts and terminology, drawing and design, mechanics, materials, welding, and machining for work in wartime production, aircraft and ship building, and weapons factories. Such programs, and women’s employment in general, were seen as fulfilling a temporary need, and once the war over and the men returned, the expectation was that women would put their educations aside and leave the workforce. Some college campuses even returned to prewar policies of denying admission to female students. Women were not so quick to give up their newly acquired skills and education, however, and some began campaigns for access to technical education and engineering jobs. The Society of Women Engineers (<http://www.swe.org>) was founded in 1946 by a group of female engineering students at Iowa State. The SWE soon spread to other campuses and cities, and incorporated as a national organization in 1952, with **Beatrice Hicks** as the first president.

The SWE also focused on dispelling myths about female engineers and on outreach and encouraging girls (and their parents) to pursue engineering education and careers, recognizing that there was a social stigma that accounted for women’s low representation in the field, and not just institutional barriers. As **Irene Peden** of the SWE acknowledged in 1965, “A girl is not likely to choose a career field disapproved by her parents, teachers, classmates, and friends.” Peden also wanted to assure young women (and men) that “[m]any women engineers are very attractive; most represent a perfectly normal cross section of femininity” (Bix 2006, 50).

Even though engineers were needed to further the war effort and for the postwar modern military-industrial needs, it was not until the 1960s that the U.S. government’s Cold War commitment to scientific research and technological advancement had an impact on women’s access to engineering education and employment. Education required subsequent access to jobs, however, and corporate-industrial culture had to change as well. Recruiters inevitably saw engineers as men, and well into the 1960s bemoaned a shortage of engineers while

rejecting qualified female applicants. The SWE reported on a survey of company managers in 1961, which found that “81 percent wouldn’t hire female engineers” (Bix 2006, 54). This attitude began to change, legally and socially, with the passage of the Civil Rights Act of 1964 and with the momentum of the new feminist movement, so that, by the 1970s, many companies proudly proclaimed their records (or at least intentions) on hiring women. For the most part, however, women’s presence in professional engineering is concentrated in more recent decades.

Although a doctorate was not always required for employment, between 1947 and 1961, women received only 24 of the more than 8,000 engineering doctorates awarded (Rossiter 1995, 82). Women still made up less than 3% of practicing engineers by the early 1980s (Trescott 1990). By 2006, that number had risen to 11.5% of employed engineers, still a marginal representation. As with computer sciences, many engineering jobs are in industry or business rather than academia and do not always require a higher degree. Of those women employed as engineers in 2006, 72% were in business or industry, and another 16.5% worked for federal, state, or local governments. Only 7.5% of women engineers are employed in colleges and universities (NSF Table H-19). In many engineering specialties, technical experience is just as important as (if not more important than) formal education. This has both benefited and, ironically, hindered women’s entrance into the engineering professions. In the nineteenth century, engineers were trained on the job in the dirty, physically demanding, and even dangerous factories, railroad yards, or survey expeditions, jobs from which women were excluded. Through the twentieth century and beyond, young boys are still more likely to be encouraged to help their fathers build things and to play with building sets (Legos, Lincoln Logs, erector sets), model car and railroad sets, electronic hobby sets, and, now, computers and video games. Girls are not specifically excluded from such activities, but these toys are marketed to boys, and girls still receive social messages about appropriate interests.

Modern engineers work in a variety of industries and applications, and women’s contributions are now widespread across disciplines, with a focus on technological or mechanical innovation. **Mildred Dresselhaus**, a physicist and electrical engineer, was an expert on semimetals and semiconductors. **Thelma Estrin**, a former vice president of the Institute of Electrical and Electronics Engineers (IEEE), was one of the earliest practitioners of clinical engineering, and pioneered the use of computers in brain research. **Martine Kempf** is a self-trained electronics engineer and computer scientist who invented a voice-recognition system for disabled persons to operate vehicles. **Christine Darden** is an aeronautical engineer who has worked on issues related to aircraft design and the environmental impact of supersonic flights during her long career at the National Aeronautics and Space Administration (NASA). **Bonnie Dunbar**, also at NASA, was an early female

astronaut and a biomedical engineer who studied the effect of space flight on the body. **Rodica Baranescu** is a mechanical engineer and in 2000 was the first female president of the Society of Automotive Engineers International.

Because of the continued low representation of women in engineering, however, combined with the importance of engineering to nearly every aspect of modern technological life, engineering seems to be one of the most organized fields in terms of commitment to recruiting more girls and women. Female engineers organize conferences, educational programs, and professional support and



Computer scientist and biomedical engineer, Thelma Estrin. (Courtesy of UCLA Media Relations)

mentoring networks, through organizations such as the SWE and the IEEE Women in Engineering network (<http://www.ieee.org/web/membership/women/index.html>). Numerous programs exist for girls, students, parents, and educators, such as the Women in Engineering Proactive Network (<http://wepan.org/>), which is funded by the National Science Foundation and also produces a K–12 engineering curriculum entitled “Making the Connection.” A program called “Engineer Your Life” (<http://www.engineeryourlife.org/>) is targeted to high school girls, and “Engineer Girl” (<http://www.engineergirl.org/>) is a program of the National Academy of Sciences.

See also Computer Sciences and Information Technology

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Environmental Sciences and Ecology

Environmental sciences is a broad category of study related to understanding the natural and human environments and the interaction between the two. It encompasses a range of disciplines and research interests that overlap among the natural, physical, and social sciences. Scientists working on environmental and ecological or ecosystem studies come from a variety of fields, including animal sciences, botany or plant biology, human biology, evolutionary biology, chemistry, geography (human and physical), geology, engineering, meteorology, oceanography, physics, toxicology, and social sciences such as anthropology, economics, politics, and public health awareness and reform.

Environmental science also informs business, government, and activist concerns. Interdisciplinary environmental studies and analyses are used in policymaking related to development, agriculture, and industrial waste management, and “green” business and lifestyles have become a major political issue and social mandate in recent years. These issues depend upon science to explain the reason or urgency for certain actions needed to offset or change the effect of humans on the environment. Current issues involving environmental scientists include climate change (global warming), protecting endangered plant and animal species, agricultural practices and food supplies (global and local), conservation of nature, air and water pollution, deforestation, and industrial and chemical health hazards and standards.

Ecology, or the study of ecosystems, is a subfield of environmental studies and refers specifically to the biological interactions and interdependency among living organisms or species (humans, animals, plants) and the natural or physical environment. **Lynn Margulis** is an evolutionary biologist who has put forth the “Gaia hypothesis,” or the idea that the Earth itself is a living organism. Although more specifically a theoretical or even spiritual issue than a scientific pursuit, ecofeminism argues that the destruction of the Earth and the social subordination of women

Women and Climate Change

Global climate change (or global warming) is one of the biggest issues for scientists, politicians, and industry of the twenty-first century. Since the mid-twentieth century women scientists have been involved in efforts to track and slow climate change, including geologists, meteorologists, oceanographers and other environmental and physical scientists, and materials and chemical engineers involved in creating new “green” technologies. The environmental effects of global climate change may have a negative social and economic impact on women, in particular. Feminist economists and other social scientists have pointed out that, especially in developing areas of the world, drought, flooding, erosion, and deforestation, as well as natural disasters caused by climate change, can have a devastating impact on local agriculture, water availability, and women’s health and economic survival. The gendered aspects of climate change have been addressed by the United Nations Commission on the Status of Women and by global development, population and sustainability conferences since the 1990s, resulting in specific policy recommendation.

are connected. Indeed, ecofeminism has sometimes been seen in opposition to science based on the idea that science is a “male” discipline with the goal of controlling or dominating nature for human use, whereas feminism promotes a “care-taker” role for humans in relation to the environment.

Although we tend to think of *environmentalism* as a relatively new concept, and *environmentalists* as a highly politicized group, the United States has a long and solid history of environmental studies and science, and of efforts to protect nature and animals. In the nineteenth-century United States, industrial revolution, urbanization, and widespread immigration and migration all raised concerns about pollution, destruction of the natural habitat, and the effect of human populations on the environment. Henry David Thoreau, in his 1854 book *Walden* and other writings, was one of the earliest American naturalists to lament humanity’s disregard for nature’s essential role in our physical as well as spiritual well-being. In the next generation, John Muir founded the Sierra Club and the twentieth-century conservation movement. By the early 1900s, politicians and reformers were taking notice and promoting conservation and protection of lands by setting aside state and national parks, such as Yosemite and Yellowstone.

By the turn of the twentieth century, women with advanced degrees were focusing on environmental issues and hazards within a variety of different disciplines, many of them as botanists, biologists, and zoologists. Beginning in the late 1800s, chemist Ellen Swallow Richards did some of the earliest research on

industrial pollution in the United States and, at the Massachusetts Institute of Technology (MIT), taught some of the first college courses in environmental science. **Emmeline Moore** (who received her Ph.D. in 1914) was an early aquatic wildlife biologist who studied the effect of water pollution on freshwater fish; Moore later served as president of the American Fisheries Society. Plant pathologist **Josephine Tilden** held a master's degree (1897), and her research on algae led her to see the connections among algae, the larger ocean ecosystem, and human health. The plant catalogs created by botanist and ecologist **Lucy Braun** (who earned a Ph.D. in 1914 and was later the first woman president of the Ecological Society of America) were used in later conservation efforts to show the effect of mining on local plant life.

In the 1920s and 1930s, the U.S. government began regulating business and industry to protect the environment as well as the health of workers and consumers. Toxicologist **Alice Hamilton** was one of the pioneers of occupational and environmental health studies, warning of the health hazards of unleaded gasoline and exposing safety issues for workers handling toxic chemicals and exposed to radiation. The spread of industrial factories and car culture by the 1950s gave rise to new levels of concern about the health hazards of smog and atmospheric and



Doctor and reformer Alice Hamilton. (Library of Congress)

water pollution. **Rachel Carson** warned of the impact of humans on nature in her now-classic book, *Silent Spring*, first published in 1962. Paul and **Anne Ehrlich** published their highly controversial work, *The Population Bomb*, in 1968, warning that overpopulation would lead to a strain on Earth's natural resources and more human deaths.

The government established the Environmental Protection Agency in 1970, but several major industrial and nuclear accidents of the 1970s and 1980s, including Love Canal and Three Mile Island in the United States, and others internationally, had tragic effects on human health and resulted in increased activism and public environmental consciousness. **Geraldine Cox** received a Ph.D. in environmental studies in

1970 and has been involved in creating chemical industry policy guidelines for disaster management. Physician **Helen Caldicott** (Physicians for Social Responsibility) has warned of the short- and long-term effects of radiation and has led the way in her campaign against the development and use of nuclear energy. The burning oil fields in Kuwait during first Gulf War in the early 1990s, the *Exxon Valdez* oil spill in 1989, and the British Petroleum *Deepwater Horizon* oil spill in the Gulf of Mexico in 2010, brought new concerns about the devastating environmental and human costs of oil acquisition and production (through drilling or through war). By the end of the twentieth century a new “green” mentality had inspired not only a public imperative for individuals to reduce their “carbon footprint,” but for more scientific research and funding for alternative energies and technologies. The melting through of the polar ice cap, the designation of new endangered animal species due to habitat destruction, and the recognition that many “natural” disasters (hurricanes, mudslides, flooding) may be linked to human actions, have all influenced the U.S. government’s scientific priorities.

Women scientists work on environmental issues from a range of disciplinary perspectives, including chemistry and engineering. In the 1970s, **Maxine Savitz**, a chemist working in the U.S. Department of Energy, developed energy standards for heating and lighting buildings, new batteries, and fuel-efficient cars; **Betsy Ancker-Johnson** worked for many years on environmental policy at General Motors (GM), warning as early as the 1980s about the automotive industry’s role in global climate change; **Kathleen Taylor** also worked at GM as a chemical expert on the development of catalytic converters to reduce emissions. **Roberta Nichols**, an engineer for Ford Motor Company, led the industry in developing alternate fuels for vehicles as well as designing vehicles that are more energy-efficient, and **Elizabeth Gross** is a biochemist who has researched photovoltaic cells, or “living batteries,” to convert sunlight directly into electricity to preserve fossil fuels and reduce pollution. Chemist **Joan Berkowitz** is an internationally known expert on environmental hazards, and **Susan Solomon** confirmed that the chlorofluorocarbons (CFC) in air conditioners, aerosol sprays, and refrigerators were contributing to the hole in the ozone layer over Antarctica, leading to a global effort to regulate and reduce use of those products.

Other environmental scientists are biologists, zoologists, botanists, and naturalists focused on animals and plants and their habitats. **Mollie Beattie**, as director of the U.S. Fish and Wildlife Service, was responsible for enforcing the Endangered Species Act in the United States. **Cynthia Moss** and **Joyce Poole** are zoologists who were active in having the African elephant declared endangered when the illegal trade in elephant tusks was decimating the herds. Continuing the environmental–naturalist connection of the nineteenth century, **Anne LaBastille** is a naturalist who has worked to preserve the wildlife habitat of many bird species,

and **Marcia Bonta** is a nature writer who has written extensively on the environment and on the history of women's roles as naturalists. Inspired in environmental science by her famous conservationist father, Aldo Leopold, **Estella Leopold** became a specialist in paleoecology, or the study of prehistoric organisms and their environments.

Geologists and geographers also add a unique perspective to the study of the Earth's environments and ecosystems. **Pamela Matson** earned a degree in forest ecology and researches the role of land-use changes on global warming. **Ruth DeFries** is an environmental geographer who uses global satellite images to understand the impact of human activities, such as agriculture and development, on the physical environment. **Jane Lubchenco** is a marine ecologist and geologist who specialized in ocean ecosystems and global climate change; in 2009, she was appointed head of the National Oceanic and Atmospheric Administration (NOAA). Women environmental scientists working within a variety of interdisciplinary frameworks are represented professionally by organizations for earth scientists in general, such as the Association for Women Geoscientists (<http://awg.org>). Other groups bring together scientists and professionals in other fields, such as business and law, around environmental concerns, such as the Women's Environmental Council (<http://www.wecweb.org>) and the Society of Women Environmental Professionals (<http://swepweb.com/>).

See also Biology; Biomedical Sciences; Botany; Geography; Geology; Ocean Sciences

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Genetics

Genetics is a branch or subfield of biology and is focused on the scientific study of heredity or inherited traits through analysis of information stored in DNA (deoxyribonucleic acid), RNA (ribonucleic acid), genes, and chromosomes, whether in humans, animals, or plants. Genetics provides insight into the most basic level of cell functioning and explains many aspects of human biology. Genetics is a fairly recent scientific discovery and one in which knowledge advanced rapidly over the course of the twentieth century. The concept of genetics was first discovered in agricultural experiments with the breeding and hybridization of plants. In the mid-nineteenth century, Austrian botanist Gregor Mendel isolated single-gene hereditary traits in pea plants. It took several more decades, however, for scientists to realize fully the implications of Mendel's findings, especially the applicability to human genetics. Charles Darwin's theories of evolution and species adaptability were the next leap in scientific understanding of heredity.

Many scientists and physicians subsequently promoted theories of inherited traits and behaviors that often had little to do with actual science and more to do with social agendas. For example, the belief that certain personality traits, interests, or even criminal behaviors could be inherited informed eugenics policy well into the twentieth century, resulting in the involuntary sterilization of criminals or others deemed deviant in an attempt to stop them from passing those undesirable social behaviors, through their genes, on to the next generation. By the 1950s, genetics science was used to promote a new set of social policies, including premarital counseling and blood testing to ensure genetic compatibility (Kline 2001).

Technology (such as the microscope) made possible the discovery of the cell and, in the early twentieth century, the discovery that genes are located on chromosomes. Around 1905, Nettie Stevens discovered that sex was a genetic factor and was determined by chromosomes. At the time, she was working at Bryn Mawr



Biochemist and geneticist, Maxine Singer.
(National Library of Medicine)

Human Genome Project and DNA Testing

The mapping of human genes has social and health implications for the lives of women worldwide. The international government-sponsored Human Genome Project (HGP) was begun in the 1990s and scientists had mapped more than 20,000 human genes by 2003. Originally a project of the National Institutes of Health, research on the human genome sequence was conducted at scientific research centers and universities in several countries. The information collected in the HGP has already had implications for the direction of research on known hereditary diseases and has inspired the search for possible genetic links to diseases such as breast cancer. Advances in DNA testing have also made it easier to screen the fetus for certain diseases during pregnancy and for the development of more accurate testing methods for conditions such as diabetes or HIV/AIDS. Besides health and medical research, DNA testing also has social implications for women and families, through paternity testing or criminal investigations. In the twenty-first century, women are involved in both scientific research and consumer interest in developing further uses for DNA testing and gene research.

with her professor, Edmund Beecher Wilson, who is credited with the discovery that chromosomes carry genes. In the 1940s, scientists confirmed that DNA (not proteins) carried hereditary information, and the double-helix structure of DNA was explained in the 1950s. By the 1980s, scientists could reproduce DNA in the laboratory, and computers allowed DNA mapping and sequencing, a new field called *genomics*. The Human Genome Project (HGP), a complete mapping of the more than 20,000 human genes, began in 1990 and was completed in 2003. The HGP allows biologists to study the particular sequences of genes for research into human evolution and disease characteristics. **Maxine Singer** is a leading figure in human genetics, and her laboratory helped to decipher the genetic code.

The study of genetics also informs our understanding of the effect of environment on human biology and health—that is, allowing scientists to determine which traits or predispositions to certain diseases are encoded in our DNA, which are the results of mutations, and the effects of our environment (health, diet, stress, etc.) on chromosomes. Reducing human life to the genetic level, however, also raises ethical concerns. For example, prenatal genetic testing has become an important tool in screening for certain diseases or conditions, but is this knowledge used to justify ending a pregnancy or to risk treating a disease before it appears? And, armed with such knowledge, who gets to make such decisions? DNA testing is also now routinely used in criminal prosecutions and even in historical research. Despite the rapid advancement of genetics as a field of inquiry, some scientists,

Nettie Stevens

Geneticist Nettie Maria Stevens (1861–1912) was one of the first researchers to demonstrate that sex was determined by a particular chromosome. Prior to her research, most biologists thought that external influences such as food and temperature determined the sex of offspring. She was the first person to establish that chromosomes exist as paired structures in body cells and the first to ascertain that certain insects have supernumerary chromosomes. Although she received recognition for her work during her lifetime, many textbooks attribute the discovery of the XY sex chromosome system to her contemporary, Edmund B. Wilson, a Columbia University biologist who made the simultaneous discovery in 1905.

Stevens received two degrees from Stanford University and studied at the Naples Zoological Station and at the University of Wurzburg. She received her doctorate from Bryn Mawr in 1903, where she continued on as a research fellow in biology and an associate in experimental morphology. Although she had a short research career, she published nearly 40 scientific papers and made an impact on the fields of genetics and embryology.

such as **Evelyn Fox Keller** and **Anne Fausto-Sterling**, have been critical or at least skeptical of the emphasis on and direction of genetic research. In her controversial 1993 book *Exploding the Gene Myth*, **Ruth Hubbard** warned that an overreliance upon genetic information may skew scientific research priorities and create ethical dilemmas in medical care, health insurance, reproductive rights, criminal justice, and environmental science. Other feminists have been concerned about the use of genetics to explain sexual orientation.

Genetics is a field of some of the most astounding and significant scientific discoveries of the last century, many of them conducted by women scientists. In the 1950s, British crystallographer Rosalind Franklin discovered that the DNA molecule was in the shape of a double helix, or two intertwining coils. She created an X-ray image of the helix, from which James Watson and Francis Crick built the model that would earn them the Nobel Prize in Physiology or Medicine in 1962, four years after Franklin's death. There have been at least 19 Nobel Prize winners in work related to genetics, including American **Barbara McClintock**, who won the Nobel Prize in Physiology or Medicine in 1983 for her work on maize (corn) genetics. McClintock spent 40 years studying mutation in kernels of maize, and discovered transposable or “jumping” genes that move from one chromosome to another. **Virginia Walbot** worked with McClintock and conducted her own research on transposable genes.

Genetic researchers may study humans, animals, or plants, all of which may inform and have implications for biomedical research on human health and

diseases. Other women scientists who have conducted research in plant genetics include **Jane Rissler** on bioengineered plants, **Sharon Long** on the genetics of legumes, **Nina Fedoroff**, who replicated McClintock's experiments on maize and found transposable elements in other plants, and **Mary-Dell Chilton** and **Marjorie Hoy** on the genetic engineering of agricultural crops. **Mary Lou Pardue** was known for her work in insect genetics, **Margaret Kidwell** studied the transfer of genes in fruit flies, informing biologists' understanding of species evolution, and **Judith Kimble** is an animal geneticist whose work on nematodes (or unsegmented worms) has implications for human embryology and genetics. **Helen Dean King's** research on heredity involved breeding pure generations of rats to be used in laboratory experiments; **Elizabeth Russell** also bred mice for her genetic studies on various hereditary diseases such as anemia, muscular dystrophy, and cancer.

Medical genetics has perhaps received the most attention, holding out promises for new understandings of and genetic therapies for diseases. **Madge Macklin** was one of the earliest medical geneticists (she received her M.D. in 1919) who focused on clinical practice and realized the importance of doctors taking into account a patient's family history for understanding certain hereditary diseases. **Elizabeth Neufeld** is an international authority on human genetic diseases, and **Mary-Claire King** is renowned for her research on breast cancer; in the 1990s King determined the existence of the gene BRCA1, which, if damaged, can predispose women to breast and ovarian cancer. Psychologist **Nancy Wexler** led the search to identify the gene that causes Huntington's disease, an inherited debilitating disease that strikes in middle age. **Mathilde Krim** is a geneticist and virologist researching cancer, tuberculosis, and HIV/AIDS. **Ruth Sager** studied nonchromosomal mammalian cell genetics, also with implications for understanding cancer and tumor growth, and hematologist **Eloise Giblett** researched gene therapy for certain inherited immune deficiencies.

See also Biology; Biomedical Sciences; Chemistry; Crystallography; Medicine

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Geography

Geography is the study of the Earth and its natural and human environments. There are two major fields within geography: physical geography and human geography. Physical geography is the study of the Earth's landforms, physical features, and natural phenomena. Human geography is the study of human spaces, including land use and built environments for social, political, and religious reasons. Feminist geography is one approach to the study of human geography and focuses on how gender, family life, and sexuality, for example, impact the use and distribution of space. This subfield has its own journal, *Gender, Place, & Culture: A Journal of Feminist Geography*. As the study of human uses of land and space, human geography has implications for a variety of nonscientific industries and policymaking, including urban planning, architecture, transportation, agricultural development, healthcare, and business. Human geography therefore includes the methods and tools of the natural sciences and social sciences, such as economics, sociology, anthropology, and politics.

Physical geography is one of the earth sciences and may include all areas of study of the planet. Geographers study the Earth's inner core and layers, the Earth's surface and land formations (such as mountains, volcanoes, canyons, and forests), the physical features of the Earth's environments and ecosystems (soil, water, climate, vegetation), and the relationships among the Earth's surface, environments, and immediate atmosphere. The primary focus of physical geography, then, is on the features and physical processes of our planet; as such, geography is highly interdisciplinary. Geographers work both in the field and in the laboratory creating computer models and analyses. They may need scientific backgrounds in (or work within) fields such as biology, chemistry, glaciology, geodesy, mathematics, meteorology, ocean sciences, and environmental sciences. Geographical research is one of the foundations of environmental studies on climate change (global warming); deforestation and habitat destruction; forest, water, and other natural-resource management; pollution; and soil erosion and flooding, among other issues.

Early-twentieth-century women geographers worked in a variety of situations as government clerks, editors, librarians, field scientists, and teachers of secondary school and college. **Zonia Baber** was one of the earliest women geographers, and a pioneer in creating geography curricula; she held a bachelor's degree and taught geology and geography at the University of Chicago in the early 1900s. **Ellen Churchill Semple** was another early woman geographer who wrote on human geography and history; in 1921, she was the first female president of the Association of American Geographers. Many early women geographers concentrated on fieldwork and exploration, and faced similar obstacles to those faced by women working in other field studies such as geology, archaeology, or paleontology.



Environmental geographer Ruth Defries.
(Courtesy of Sandy Schaeffer, University
Publications, University of Maryland)

Louise Boyd was not trained as a scientist, but she personally funded several explorations of the Arctic region, creating some of the earliest maps, photographs, and records of the region; she represented the United States at the 1934 International Geographical Congress.

Modern geographers work on creating mathematical and computer models for problems in both physical and human geography. **Irene Fischer** was a renowned mathematician and geodesist; geodesy is the measurement of the shape and size of the Earth and requires measurement of large tracts of land, mapping the exact positions of geographical points, and determining the curvature, shape, and dimensions of the

Earth. Fischer worked for the U.S. Army's Defense Mapping Agency Topographic Center and later provided the National Aeronautics and Space Administration (NASA) with precise topographical data on both the Earth and the seas in order to plan and execute experimental flights. **Gwen Bell** studied urban planning and computers for her doctorate in geography, and was known for creating an early computerized geographic mapping system, and **Ruth DeFries** is an environmental geographer who studies the effect of humans (through agriculture, urbanization, and carbon emissions) on the Earth's habitats and ecosystems.

As in many scientific fields, the numbers of women receiving doctorates in geography was relatively stable until the 1970s and 1980s, and has increased significantly since then (Monk 2004). Women in geography receive professional support and resources from organizations such as the group Supporting Women in Geography (<http://www.geography.wisc.edu/swig/index.htm>) and from broader professional societies within the earth sciences, such as the Association for Women Geoscientists (<http://www.awg.org>).

See also Economics; Environmental Sciences and Ecology; Geology; Meteorology; Ocean Sciences; Sociology

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Geology

Geology is the study of the Earth's physical materials, and their history, formation, processes, and uses. Geological subfields include petrology (the study of rocks), stratigraphy (the study of sedimentary layers), and structural geology (the study of land formations), and their work may include paleontology (the study of fossils), and the study of glaciers and ice. There are also planetary geologists who study the surface structure and formation of other planets besides Earth. Geologists have many tools, methods, and areas of focus, including various types of mapping, field observation, underground radar and electrical sensing, drilling, and biological and chemical analysis. Their research may support a variety of nonacademic interests in the identification and extraction of resources such as minerals, petroleum products, coal, natural gas, and water. Their work also has implications for civil engineering and for emergency planning through the study of natural disasters such as earthquakes, avalanches, volcanoes, and landslides. Finally, geological research has implications for and supports work and policy issues related to global climate change.

Ancient explorers and philosophers were interested in collecting and classifying types of rocks, minerals, and metals. By the early eleventh century, geologists in the Islamic world and in China were formulating theories on the former submergence of continents under the sea, on the formation of mountains and other landforms, and on the origins of earthquakes, based on the discovery of different rock layers (strata) and on observations on the diversity of the Earth's terrain. The age of European exploration brought new geographical and geological information through mapmaking and through economic activities such as mining. James Hutton published his *Theory of the Earth* in 1795, and, along with major fossil discoveries of the early nineteenth century, set off a new course of geological studies devoted to establishing the age of the Earth based on rock formation and layers. Hutton (and, a few years later, Charles Lyell in his *Principles of Geology*) promoted the idea that the Earth is constantly changing, challenging the biblical version of geological events in which the Earth was formed via a single event and remains unchanged

Mary Lyell

Mary Elizabeth Horner Lyell (1808–1873) was an English naturalist and geologist who specialized in conchology, or the study of shells. She was married to Charles Lyell, the founder of modern geological science, whose book, *Principles of Geology* (1830–1833), established that the Earth itself had a history, an idea that directly influenced the theory of evolution made famous by their contemporary, Charles Darwin. Lyell made a further contribution to the theory of human evolution with his work on *Geological Evidences of the Antiquity of Man* (1863).

Mary Lyell received a thorough education in the sciences; her father was a professor of geology and her sister became a botanist. Like other nineteenth-century professional wives (such as her friend, Elizabeth Agassiz), Mary's contribution to her husband's scientific endeavors and publications is acknowledged as central, but difficult to measure. The Lyells traveled together on geological expeditions throughout Europe and North America, with Mary collecting and cataloging fossil and rock specimens. She read several European languages and assisted her husband in translating and reading scientific papers, and in corresponding with other scientists around the world. Charles Lyell supported the participation of other women in scientific circles by insisting that women be allowed to attend his lectures, and Mary Lyell regularly attended meetings of the London Geological Society.

from its origins. By the mid-nineteenth century, the works of Charles Darwin supported the idea of a changing Earth and became the standard for scientific knowledge in the geosciences. In the twentieth century, the discovery of plate tectonics confirmed the movement of the continents, and new technologies have allowed for geological study of the ocean floor, carbon dating of rocks and fossils, seismological understanding and even prediction of earthquakes, and computer modeling of the Earth's different layers.

Geology is a subfield or specialty within earth sciences. Women earned only 4% of earth science doctorates between 1920 and 1970 (Aldrich 1990, 64). Even as access to higher education expanded, it was difficult for women to find jobs and, when they were hired, they received lower pay than their male colleagues. By 2001, women were earning nearly 40% of bachelor's degrees in the geosciences, which includes all earth, atmospheric, and ocean sciences; this figure was up from about 25% to 30% ten years earlier. Women earn a similar percentage of graduate degrees, although the actual numbers of doctorates granted in the field is quite small, with only about 250 women earning Ph.D.s in the geosciences in 2003. Despite gains over the past decade, however, women geoscientists are still glaringly underrepresented at higher faculty levels, as is the case across the sciences.

In the 2004–2005 academic year, women made up 26% of assistant professors, but only 8% of full professors in the geosciences. The numbers of minority women in the geosciences is also disproportionately low; for example, only 107 African Americans (and only 30 African American women) earned a doctorate in geosciences in the 30-year period between 1973 and 2003 (AWG 2005).

As in physical geography, ocean sciences, or environmental studies, geology requires both field and laboratory work, addressing both theoretical and practical problems and applications. In the United States, geology was one of the foundations of all American science and was important for the exploration and utilization of newly discovered regions and natural resources. In the nineteenth century, women were prominent as collectors of rocks, minerals, and fossils, as illustrators and recorders of natural history, and as creators of topographical maps. Early women geologists were trained and employed at the women's colleges, at secondary schools, in museums, and in government field stations. One of the earliest women to earn a doctorate in geology was Mary Emilie Holmes, who earned her Ph.D. from the University of Michigan in 1888 and was the first female member of the Geological Society of America. **Florence Bascom** received her Ph.D. in geology from Johns Hopkins in 1893 and is considered the first female professional geologist. Bascom was a petrologist who was one of the first scientists to use the microscope to study mineral crystals and was also the first woman scientist hired at the U.S. Geological Survey (USGS), which was established in 1879. Bascom built the department of geology at Bryn Mawr and trained several other early women geologists who went on to get their doctorates at other institutions, including **Ida Ogilvie** (Ph.D., Columbia, 1903), **Julia Gardner** (Ph.D., Johns Hopkins, 1911), and **Eleanora Bliss Knopf** (Ph.D., Berkeley, 1912). Both Knopf (a petrologist) and Gardner (a paleogeologist who studied shell fossils and created maps of Pacific islands) also worked for the USGS. Gardner later served as president of the Paleontological Society in 1952; **Winifred Goldring** had been the first female president of that organization just a few years earlier, in 1949.

Geologists have worked closely with paleontologists and other scientists to uncover the history of the Earth and its inhabitants through the sedimentary and fossil record. **Christina Lochman-Balk** researched invertebrate fossils and several women were heavily involved in the research project begun by Nobel Prize-winning physicist Luis Alvarez to determine whether a meteor was responsible for the disappearance of dinosaurs from the Earth. Nuclear chemist **Helen Michel** conducted analyses of specimens from the sedimentary record believed to be evidence of the meteor; planetary geologist **Adriana Ocampo** worked for the National Aeronautics and Space Administration (NASA) when she helped confirm the location of the crater created by the meteor, which was found under the sea; and **Susan Kieffer**, an expert on volcanoes and crater impacts on other planets,

advised the team on the characteristics of a crater site and on the possible trajectory of the asteroid. Astronomer **Lucy-Ann McFadden** was the principal investigator for NASA's planetary geology program, and **Ursula Marvin** is a planetary geologist who studies lunar rocks and meteorites.

Other women geologists have been explorers, chemists, physicists, and ocean scientists, conducting research for a variety of government and industrial projects. **Katharine Fowler-Billings** was an explorer and field geologist beginning in the 1930s and 1940s who conducted mineral expeditions throughout North America and on the Gold Coast of Africa. **Gisela Dreschhoff** is a geophysicist of the polar regions who conducted surveys in Antarctica to locate radioactive materials such as uranium. **Della Roy** is a geochemist who studies the properties of materials for different uses (the mineral *dellaite* is named for her), and **Alexandra Navrotsky** is a geochemist who researches the composition and thermal chemistry of the Earth. **Mary Lou Zoback** is a geophysicist who specializes in plate tectonics and earthquake fault lines.

Others interested in plate tectonics and seismology have focused on the geology and geography of the ocean floor. **Elizabeth Bunce** was a geophysicist who spent a long career at Woods Hole Oceanographic Institution studying marine seismology and underwater acoustics. **Marie Tharp** studied underwater geology and created some of the first maps of the ocean floor, including her discovery of the valley that divides the Mid-Atlantic Ridge. **Marcia McNutt** also mapped and measured the depth of the sea floor and researched plate tectonics; McNutt was the director of the Monterey Bay Aquarium Research Institute until 2009, when she was named the first female head of USGS.

The American Society of Geologists and Naturalists was formed in the 1840s and was one of the scientific organizations subsumed under the new American Association for the Advancement of Science (AAAS). As it has application to a wide range of scientific pursuits and discoveries, geology is included within the same professional societies and academic departments as geography, geochemistry, geophysics, and other earth sciences. Scientific organizations include the Geological Society of America (<http://www.geosociety.org>), which in 2008, for first time ever, had both a woman president (Judith Parrish) and vice president (hydrogeologist Jean Bahr), and the American Geological Union (<http://www.agu.org>), a cross-disciplinary organization that includes earth, ocean, atmospheric, and planetary geology. Additionally, women scientists are represented through the Association for Women Geoscientists (<http://www.awg.org>), which was founded in 1977, and specialty groups such as the Association of Women Soil Scientists (<http://www.awss.org>).

See also Astronomy and Astrophysics; Environmental Sciences and Ecology; Geography; Paleontology; Ocean Sciences

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Home Economics

See Economics; Nutrition and Home Economics

Mathematics

Mathematics is the theory and application of using numbers and symbols in calculating measurements, spatial relationships, shapes, and patterns. Since ancient times, humans have had practical or economic reasons for establishing systems for counting, recording, and calculating physical objects. Humans also had an early need for creating abstract concepts, such as time and seasons, necessary, for example, in agriculture. Mathematics also provides the theoretical foundation and rules of logic for many scientific principles and rules and thus is the foundation of the natural sciences (physics, chemistry, astronomy) and applied sciences (computer sciences and engineering), as well as the social sciences (economics). Although scientists in these various fields must have strong backgrounds in applied mathematics, many mathematicians work in *pure* mathematics, or the study and development of mathematical principles for their own sake, without application. In most cases, mathematics is therefore related to, but still seen as separate from, work in the sciences. For example, to speak of education and work in STEM (science, technology, engineering, and mathematics) fields clearly separates out the distinct realms of each.

The perception that math is somehow different or more "pure" than the other sciences has had implications for the status of women in the field. Math, like physics, is at the top of the science hierarchy, and the belief that success in mathematics is based on pure talent or "genius" (rather than education) has been used to explain the underrepresentation of women in higher-level mathematics. This belief has implications for the education of girls and women beginning in the elementary years, when girls are not expected to show an interest in or talent for math. Beginning in the 1970s and 1980s, feminist reformers pushed for more attention to the



Mathematician Grace Hopper was an early computer programmer who helped develop the COBOL language. (U.S. Department of Defense)

math education of girls, and the elimination of gender bias in the classroom and in testing, recognizing that early math education is the foundation for women's later career choices and success in a variety of science, engineering, and medical fields. Still, even as women's presence in the field increased throughout the twentieth century, the assumptions and attitudes about women's mathematical interests and abilities continued. In perhaps no other scientific field has the debate about differences of ability been so centered on gender, and the issue has engaged scientists in other fields. From neuroscientists to reproductive biologists to psychologists, scientists want to know if math ability (defined as logic or spatial reasoning) is somehow related to the structure of our brains, to sex hormones, or genetics, or if it is entirely explained by education and social expectations (Henrion 1997; Dweck 2007).

The history of American women's presence in higher-level mathematics follows that of other sciences. Women benefited from the expansion of educational and professional opportunities in the late nineteenth century, and then faced a backlash and retrenchment of opportunities in the mid-twentieth century. Winifred Edgerton was the first American woman to earn a doctorate in mathematics, receiving her Ph.D. from Columbia University in 1886. Other early women mathematicians included **Anna Johnson Pell Wheeler** (Ph.D., University of Chicago, 1910) and **Olive Hazlett** (Ph.D., University of Chicago, 1915). The low point of women's representation in the field was the 1950s and 1960s. Between 1947 and 1961, women earned just 5.53% of mathematics doctorates (Rossiter 1995, 80). Still, some women of this generation stood out for their mathematical contributions in the post–World War II era. **Grace Hopper** and **Margaret Butler** both worked on the early military and government development of digital computers; **Mina Rees** also worked on military applications for jet rocket propulsion and high-speed computers after World War II; **Evelyn Boyd Granville** was one of

Emmy Noether

German mathematician (Amalie) Emmy Noether (1882–1935) is considered one of the greatest mathematicians of the twentieth century. She was one of the earliest figures in twentieth-century theoretical physics, devising mathematical theorems for several concepts later found in Einstein's general theory of relativity and writing numerous technical papers on abstract algebra. As the University of Erlangen (where her father was a mathematics professor) did not accept female students until 1904, she attended the University of Göttingen before returning to Erlangen to receive her Ph.D. in 1907. She worked as an unpaid lecturer at Erlangen until 1915 and held only an honorary position at Göttingen, although she did eventually earn a small salary as a lecturer. It was difficult enough for a woman to find regular university employment at that time, but in 1933, she and the other Jewish faculty members were dismissed from their positions under Nazi rule. She emigrated to the United States, where she had several employment offers, and accepted a position at Bryn Mawr College under a grant from the Rockefeller Foundation. She also lectured and conducted research at the Institute for Advanced Study at Princeton University but died in 1935, just two years after arriving in the United States.

the first black women to earn a Ph.D. in mathematics (from Yale in 1949) and worked for private industry in support of National Aeronautics and Space Administration (NASA) space missions. **Gertrude Cox** was president of the American Statistical Association in 1956 and the Biometric Society in 1969.

After the 1970s, the influence of feminism, and new attention to early math education, brought a push for gender equity in education, recruitment, and retention of women in mathematics. By 2006, women earned 45% of bachelor's degrees in mathematics and statistics and 29.6% of Ph.D.s. This was a greater representation than in related fields such as physics (in which women earned only 16.6% of doctorates), engineering (20.2%), or computer sciences (21.3%) (NSF Table F-2); at the same time, women made up a little more than 27% of doctoral-level employed mathematicians (NSF Table H-7). Thus, despite the sense that mathematics is still more heavily male-dominated than some other fields, the numbers of women with doctorates and employed in mathematics fields are actually consistent with women's representation throughout science, technology, and engineering fields; in some cases, their representation is greater than in comparable fields, such as physics.

Mathematicians work in academic research and teaching, as well as in a variety of applied settings for business, industry, medicine, and government. Persons with mathematical training and education may work as economists, statisticians,

computer scientists, and engineers. **Joan Rosenblatt** worked as a statistician establishing unified units of measurement for the National Institute of Standards and Technology. **Irene Fischer** had a background in mathematics and worked as an earth scientist in the field of geodesy, the measurement of the size and shape of the Earth. **Rosalie Bertell** was a pioneer in the field of biomathematics, using mathematical theory and probability studies to assess biomedical risks including risks from radiation; before her, **Hilda Geiringer (Von Mises)** had also been interested in applying mathematical theory to genetics and other bio-information. Others were renowned as educators. **Grace Bates** was a teacher who contributed several papers on algebra and probability theory to technical journals and was the co-author of two books. **Edith Luchins** pioneered the field of mathematical psychology and focused on the role of gender in learning and teaching mathematics.

Others have worked primarily in mathematical theory, such as **Mary Ellen Rudin** on abstract geometry, and even theoretical physics, such as **Karen Uhlenbeck** and **Marian Pour-El**. **Carol Karp** introduced new symbols to the theory of infinitary logic. **Julia Robinson** developed a hypothesis for solving an equation proposed in 1900 and known as “Hilbert’s Tenth Problem”; a Russian mathematician solved the equation based on Robinson’s hypothesis. **Olga Taussky-Todd**—known for her work in algebraic number theory and matrix theory, which she helped popularize—was founding editor of the journal *Linear Algebra and Its Applications*. Academic mathematician **Cathleen Morawetz** became the first female director of the Courant Institute of Mathematical Science at New York University. Female mathematicians are represented through professional organizations such as the Association for Women in Mathematics (<http://www.awm-math.org>).

See also Computer Sciences and Information Technology; Engineering; Physics

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Medicine

While some individuals may be trained in biomedical or health research fields, *medicine* here refers to the clinical practice of treating patients as physicians, surgeons, or other medical practitioners. Physicians focus on health maintenance as well as the prevention and treatment of illness and disease. Medical doctors (those with an M.D. degree) do not work alone, however, and usually oversee a team of other healthcare professionals. These may include nurses, physician's assistants, laboratory scientists, physical therapists, pharmacologists, anesthesiologists, radiation technicians, or other specialists specific to the needs and conditions of individual patients. All medical doctors receive basic scientific training in biology, anatomy, physiology, pharmacology, and pathology as tools for diagnosing and treating illness or disease. Physicians also typically specialize, either by patient group (gerontology, pediatrics, women's health), by organ or system (dermatology, urology, pulmonology), or as surgeons, general or further specialized. Women work throughout the medical profession as doctors and in these other positions, and may be employed in private practice, in group offices or hospitals, or in government and the military.

The care and treatment of the sick has traditionally been the role of women, and throughout history, women developed specialized knowledge about herbal medicines, palliative treatments, and specific areas of assistance, such as midwifery. In the United States, the late eighteenth and early nineteenth centuries brought the first professional medical schools, and the American Medical Association (<http://www.ama-assn.org>) was founded in 1847; the AMA did not admit its first female member until 30 years later, in 1876. Despite the barriers to advanced education and professional affiliation, women made great strides in medicine in the nineteenth century. Elizabeth Blackwell was the first woman to earn a medical degree, from Geneva Medical College in New York in 1849. A few years later,

Florence Nightingale

Florence Nightingale (1820–1910) was an English nurse renowned for her work with injured soldiers during the Crimean War of the 1850s. Her name became synonymous with women's self-sacrificing care of the sick and injured, but she helped establish nursing as a serious profession for women. As a teenager, she decided (against her parents' wishes) to pursue a career in medicine, eventually securing a position at a women's hospital in London. After hearing reports of the horrifying conditions on the battlefield, in 1854, Nightingale volunteered to lead a group of nurses to the main British camp in Crimea, near Turkey. Patients were dying in greater numbers from infections, poor nutrition, and contagious diseases than from battle wounds, and she set up a plan not only for medical care but for sanitizing the wards and improving ventilation. She herself became ill and was forced to return to England in 1856, but remained committed to public health and hygiene issues and to nursing education throughout her life. She published her foundational text, *Notes on Nursing*, in 1859, and with American physician Elizabeth Blackwell opened the Women's Medical College in England in 1869. What is less known about Nightingale is that she was a pioneering statistician who designed her own diagrams and charts to report on hospital conditions, mortality, and public health issues. She was one of the first women to be affiliated with both the Royal Statistical Society and the American Statistical Association.

Blackwell, along with her sister, Emily, and another doctor, Marie Zakrzewska, opened the New York Infirmary for Women and Children, where they trained and employed female doctors. In 1864, Rebecca Lee Crumpler became the first African American woman to receive an M.D. degree, receiving her medical training at the New England Female Medical College in Boston.

In the late nineteenth, many women earned medical degrees at separate medical schools for women. The next generation, however, would push for access to and employment in traditionally male (and thus more prestigious) medical schools. **Florence Sabin** received her M.D. from Johns Hopkins School of Medicine in 1900 and also became the first female faculty member of the medical school. Sabin also distinguished herself as the first female president of the American Association of Anatomists, in 1924, and the first woman elected to the National Academy of Sciences in 1925. **Helen Taussig** was another early Johns Hopkins graduate, receiving her M.D. in 1927. Other schools were slower to admit women; Harvard Medical School did not open its doors to female students until 1945.

Other early women physicians who were medical researchers included **Dorothy Reed Mendenhall**, who also received her M.D. from Johns Hopkins in 1900, and who researched Hodgkin's disease and issues related to infant health and

Elizabeth Blackwell

Elizabeth Blackwell (1821–1910) was the first woman in the United States to earn a medical degree, graduating from Geneva Medical College in New York in 1849. She promoted the medical education of women and went on to establish her own hospital for training female physicians. Born in England, Blackwell's family emigrated to the United States when she was a child. She began her career as a teacher, but educated herself in medicine by reading in the libraries of physician friends. She was rejected by a dozen U.S. medical schools before being accepted to Geneva, where the student body had voted for her admission as a joke. Still, she was able to attend and complete her education and practiced medicine in England, France, and the United States. In 1857, she and two other women doctors—her sister Emily Blackwell and Marie Zakrzewska—opened the New York Infirmary for Women and Children; during the American Civil War, they trained women as nurses for the Union Army. Throughout her career, Blackwell was active in the women's rights movement (her sisters-in-law, Antoinette Brown Blackwell and Lucy Stone, were both prominent reformers), and she published on issues related to women's education, professional opportunities, and health.

mortality. **Elise L'Esperance** received an M.D. from Women's Medical College of New York in 1900 and led a public health and information campaign through her clinics to promote early detection and treatment of cancer. **Ida Hyde** earned an M.D. from Rush College in 1911 and was the first female member of the American Physiological Society. **Virginia Apgar** developed the Apgar scoring system for evaluating newborn health and became the first female full professor at Columbia University's medical school in 1952. The AMA elected a female vice president in 1969, but the primary professional organization for medical doctors did not elect its first female president until 1998, more than 150 years after its founding; the AMA elected its second female president, Nancy Nielsen, in 2008.

By the end of the twentieth century, women had a greater presence in medicine than in other scientific fields in general. In the 40-year period between 1968 and 2008, the number of female medical school students rose from 8.8% to 47.9% (AAMC Table 31). During that same time period, the number of women as practicing physicians also rose, from 7.6% of all physicians to 26.6% (Boulis and Jacobs 2008, 42). These numbers are the result of women's greater access to education and the professions after 1970, but also reflect the growth of the healthcare industry in general. As faculty of medical schools, however, there are similar patterns to those of women's employment in academic science in general. In 2006, women made up 33% of all clinical medical faculty, but the numbers dwindle the higher up the academic career ladder one moves. Women accounted for 38% of assistant (nontenured)

Françoise Barré-Sinoussi

French virologist Françoise Barré-Sinoussi (b. 1947) received the Nobel Prize in Physiology or Medicine in 2008 for her discovery of HIV, the human immunodeficiency virus that causes AIDS. She shared the prize with her colleague in this work, Luc Montagnier, and with German scientist Harald zur Hausen, for his discovery of the human papilloma viruses (HPV) that causes cervical cancer. Barré-Sinoussi has been affiliated with the Pasteur Institute in Paris since the 1970s and is currently director of the Regulation of Retroviral Infections Unit. She began her career studying the link between viruses and cancers, such as leukemia, and by the early 1980s was part of a team researching a new epidemic among homosexuals as reported by the U.S. Centers for Disease Control. The scientists at the Pasteur Institute had isolated the virus by early 1983 and presented the data that linked the new HIV virus to what became known as acquired immune deficiency syndrome, or AIDS. Since that time, Barré-Sinoussi has focused on vaccine research and on international efforts to prevent, test for, and treat HIV/AIDS, including understanding and preventing mother–child transmission, in countries throughout Africa and Asia.

professors, 27% of tenured associate professors, and only 15% of full professors in the clinical sciences (AAMC Table 3). Furthermore, the American Association of Medical Colleges listed only 14 individual women as deans or interim deans out of 130 accredited medical schools in the United States in 2006 (AAMC Table 12).

As in the sciences in general, women are better represented in some medical fields or specialties than in others. A survey of medical residents in 2005 found that, within the clinical sciences, the largest percentage of women (those in which women made up 50% or more of the residents) were training in dermatology, family medicine, obstetrics and gynecology, pathology, pediatrics, and psychiatry. Women are therefore substantially represented in fields related to the primary care of women and children, and to the “helping” professions. The lowest percentage of women is seen in surgery and a variety of surgical specialties, fields that are the most prestigious, and highest-paid, among medical specialties (AAMC Table 2). The increasing numbers of female doctors overall has an impact on the quality and focus of healthcare services and research. The medical specialties with larger numbers of women are not only those that cultivate long-term one-on-one relationships with patients (which may be more attractive to some women), but are also career choices in fields that make it easier for work/life balance; that is, primary-care physicians are more likely to have regular office hours, and are less focused on research or publication and (in most cases) less likely to be subject to unscheduled emergencies or surgical calls.



Physician Virginia Apgar attending a newborn baby, 1957. She created the Apgar Score, the first standardized method for evaluating newborn health. (National Library of Medicine)

Besides the impact on the careers of individual women as physicians, women as patients and consumers of healthcare has also been a subject of inquiry since the 1970s, and reformers and female medical professionals have pushed for new studies and funding for women's and minority health issues. The National Institutes of Health (NIH) established guidelines requiring female subjects in all government-funded medical and pharmacological research proposals, and sponsored new studies on women and heart disease, osteoporosis, AIDS, and breast and other cancers. At the grassroots level as well, the women's health movement encouraged women to take control of their own bodies and health, with projects such as the book *Our Bodies, Ourselves* (<http://www.ourbodiesourselves.org>), which has gone through numerous editions and been translated into several languages, the National Black Women's Health Project (<http://www.blackwomenshealth.org>), the National Women's Health Network (<http://www.nwhn.org>), and other health advocacy and consumer groups. Geneticist **Mary Harris** founded Journey to Wellness (<http://www.journeytowellness.com>), an organization committed to African American health issues and information, and psychologist **Jane Delgado** is the president

***Our Bodies, Ourselves* and the Women's Health Movement**

The book, *Our Bodies, Ourselves*, was first published in 1973 and became a classic of the American women's health movement. Published by the Boston Women's Health Book Collective, the book was the result of a grassroots movement of women inspired by feminism to encourage women to take charge of their own health. The project was radical at the time of its publication for its open discussion of sexuality (including lesbianism), women's sexual health, body image, gender identity, violence against women, menstruation, pregnancy and childbearing, abortion, mental health, and other general health issues. Although incorporating the latest medical information available, the collectively-authored book was grounded in women's first-hand experiences and rejected the male-dominated medical profession's dismissal or pathologizing of women's issues and sexuality. *Our Bodies, Ourselves* has gone through several editions, sold millions of copies, and has been published in more than 20 languages. It has also inspired companion volumes on specific topics, such as *Ourselves, Growing Older*, *Our Bodies, Ourselves: Menopause*, *Our Bodies, Ourselves: Pregnancy and Birth*, and a special volume for teens.

and CEO of the National Alliance for Hispanic Health (<http://www.hispanichealth.org>). **Helen Gayle** is a pediatrician and public-health epidemiologist who became the director of CARE USA, a humanitarian agency that addresses poverty, education, and healthcare as social issues, and **Susan Love** left a surgical career to focus on legislative, funding, and research commitments to ending breast cancer and to empower women with the latest information on treatment alternatives. Anthropologist and nurse-midwife **Ruth Lubic** founded an organization in Washington, D.C., committed to the care of families with children.

Other women physicians have been prominent in government and research positions. In 1990, President George H. W. Bush appointed **Antonia Novello** as the first woman, and first Latino, U.S. Surgeon General; **Joycelyn Elders** was the second female Surgeon General, serving under President Bill Clinton. Cardiologist **Bernadine Healy** has served as president of the NIH and the American Red Cross, as well as president of the American Heart Association; in each of these roles, Healy has focused on the healthcare needs of women and minorities. Several astronauts and National Aeronautics and Space Administration (NASA) scientists have been trained in medicine, including **Mae Jemison**, who studied weightlessness and motion sickness, and **Irene Long**, who served as chief of the Occupational Medicine and Environmental Health Office at NASA, overseeing the health and safety of the astronauts and other NASA employees. Eight American women have been awarded

the Nobel Prize in Physiology or Medicine, but these have all been Ph.D.-holding biomedical researchers and not physicians.

See also Biochemistry; Biology; Biomedical Sciences; Genetics; Neuroscience; Psychiatry and Psychology

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Meteorology

Meteorology is the science of the Earth’s atmospheric processes and phenomena, including short-term weather forecasting. Meteorology is related to climatology, the longer-term study of the climate, including weather patterns, air pressure,



Marine ecologist and conservation biologist, Jane Lubchenco. In 2009 she was chosen as head of the National Oceanic and Atmospheric Administration, the first woman to hold that post. (AP/Wide World Photos)

humidity, and temperature, either locally or globally. Another branch of meteorology is hydrology, which is the study of the Earth's water resources, whether ground or air, and overlaps with work in geography, geology, and environmental sciences on sustainability and use of resources. Meteorologists provide weather information to the general public via the media, but also inform (and may be employed in) the military, aviation, space, and maritime industries, and local and national governments for purposes of natural disaster preparedness. Many meteorologists in the United States are employed as forecasters for the National Weather Service of the National Oceanic and Atmospheric Administration (NOAA). In 2009, **Jane Lubchenco**, a marine ecologist who specialized in global climate change, was named

the first female head of NOAA. Meteorology is usually considered one of the earth sciences, and education and training may occur under combined interdisciplinary programs for earth, atmospheric, and ocean sciences.

Even ancient societies had a material interest in observing and predicting weather events and changes, primarily for planning in agriculture. Early weather observations and forecasting went hand in hand with astronomy, as an understanding of the solar and lunar cycles informed the understanding of seasons, winds, rainfall, and other weather patterns and events. In the age of exploration, sailors recorded tropical and other ocean-related weather events that aided future travelers, and in the eighteenth and nineteenth centuries, the first weather maps (or atlases) were published and the Celsius temperature scale was created. The U.S. Weather Bureau (now the National Weather Service) was first established in 1870 and later became part of the U.S. Department of Agriculture. The first weather-observation stations were also established, and soon an international network of weather information and a standardized form of communication was needed. By the mid-twentieth century, computers and satellites aided these efforts, making it possible to map global weather patterns and generate statistical analyses for forecasting.

The actual numbers of trained meteorologists remains small, but a few women have stood out in the field since the mid-twentieth century. The national Weather Bureau began to employ many women during and after World War II; some of these were only temporary workers, but others built careers in meteorology out of this experience. **Florence Van Straten** monitored weather conditions for the Pacific fleet during the war and went on to work for the Naval Weather Service as a civilian meteorologist, providing weather forecasting to support military operations, such as launching long-range missiles. **Pauline Morrow Austin** held a Ph.D. in physics and worked as a “computer” in the Massachusetts Institute of Technology (MIT) Radiation Lab before being trained as a meteorologist during World War II. **Joanne Simpson** was the first woman to receive a doctorate specifically in meteorology (earning her Ph.D. from the University of Chicago in 1949) and worked as a forecaster for the military during World War II; she also held several positions at NOAA and was the first female president of the American Meteorological Society (1989). **Bernice Ackerman** was also trained as a meteorologist during World War II and went on to earn a doctorate in meteorology in 1965; she is considered the first female weather forecaster in the United States, and worked as a research meteorologist in the Cloud Physics Laboratory at the University of Chicago and as the first woman meteorologist at Argonne National Laboratory.

In the 1970s, Joanne Simpson and **Margaret LeMone**, an observational meteorologist whose research focuses on storm and cloud systems and who received her Ph.D. in 1972, began tracking the education and careers of women in meteorology. They found that, between 1971 and 1976, women earned just 3.3% of the more than 500 doctorates awarded in meteorology (LeMone et al. 1984). Women’s representation in the field rose significantly over the subsequent decades. By 1999, women earned 17.7% of doctorates in the field of atmospheric sciences; by 2006, that number had risen to 31.3% (NSF Table F-2). Again, the overall numbers of meteorology or atmospheric science doctorates and professionals remains small; the 2006 number, for example, represents only 46 women out of a total of 147 doctorates in atmospheric sciences awarded that year (NSF Table F-1).

Women meteorologists continue to make important contributions in government, industry, and academic settings, especially as global climate change has become an important social and political issue of our time. **Tamara Ledley** is known for her research on the role of the polar regions in shaping climate and has examined how the interaction of atmosphere and sea with ice and oceans influences climate change. She has conducted research in both Alaska and Antarctica, and been active in presenting information on climatology to elementary school children as well as to university students. **Eugenia Kalnay** received a Ph.D. in meteorology from MIT in 1971. Kalnay uses computer models and analysis to make numerical global weather predictions based on ocean and atmospheric climates and has been

one of the most outspoken voices on the role of humans in global climate change. Atmospheric scientist and engineer **Susan K. Avery** had a long career in academia before being appointed the first female director of the Woods Hole Oceanographic Institution in 2008. Scientists in the field may be affiliated with the National Weather Association (<http://www.nwas.org>) and the American Meteorological Society (<http://www.ametsoc.org>).

See also Astronomy and Astrophysics; Environmental Sciences and Ecology; Geology; Geography; Ocean Sciences

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Neuroscience

Neuroscience is the study of the brain and nervous system, and may include scientists working in a variety of backgrounds, fields, and subdisciplines, including cellular and molecular neurosciences, neuroscience systems, pharmacology, behavioral or cognitive neuroscience, neurolinguistics, developmental neuroscience, evolutionary neuroscience, and brain diseases, disorders, or injuries. Neuroscientists may focus on the chemical, genetic, or behavioral aspects of brain science. Neuroscience differs from psychiatry, however, in its foundation in the physical structure and processes of the brain and nervous system.

Numerous ancient cultures observed the effects of brain damage and many engaged in practices to relieve physical and mental pain, such as cranial drilling. The exact function and structure of the brain, however, was not understood for many centuries. In some sense, phrenology and early psychology and philosophy of the nineteenth century were precursors to neuroscience, in that these scientific endeavors sought to understand the relationship between the brain and the mind, or between the physical structure of the brain and human thought and behavior. Microscope technology allowed scientists in the late nineteenth century to study brain tissues and led to the discovery of nerve cells, or neurons. Neuroscientists in the twentieth century have focused their research on the function or role of specific parts of the brain, finding that certain regions of the brain correspond to different behaviors and skills, such as language, movement, or organ function. Other researchers focus on the chemical, hormonal, or environmental influences upon the brain and nervous system. Neuroscience as it exists today, then, is a relatively new field, made possible by great technological advances in radiology and computer imaging that allow us to see what is going on inside the human brain.

In 1963, women earned just 10% of higher degrees in neuroscience; by 1973, that number had increased to 20%. Although the numbers and status of female students, faculty members, and researchers are sometimes difficult to track since neuroscientists may be working within a variety of interdisciplinary fields and settings related to the biological or life sciences, most reports show a continued increase in women's numbers in neuroscience. By 1998, women made up as many as 45% of graduate students in the neurosciences, approximately 31% of assistant (nontenured) professors, but still less than 20% of tenured full professors (Haak 2002). This is a "leaky pipeline" pattern found throughout the sciences in which there are fewer women at each successive stage of the career ladder.

Elizabeth Crosby, who earned a Ph.D. from the University of Chicago in 1915, was one of the earliest women brain researchers and published several textbooks on neuroanatomy and neurosurgery. **Barbara Brown** was trained in pharmacology and was another among the first generation of women in neuroscience. Brown received her doctorate from the University of Cincinnati in 1950 and was a pioneer researcher in the concept of "biofeedback," a method of learning to control one's bodily functions by monitoring one's own brain waves and other bodily functions. A professional organization, Women in Neuroscience (WIN) was founded in 1980 to support women in careers in neuroscience. WIN (now the Committee on Women in Neuroscience, <http://www.sfn.org/index.cfm?pagename=womenin-neuroscience>) was founded by **Candace Pert**, a neurophysiologist who, as a graduate student, co-discovered the brain's opiate receptors, the areas in which painkilling substances such as morphine can be inserted. Her work led to the



Neurophysiologist Candace Pert with a CAT scan of a brain. Pert researches the connection between brain chemicals and emotions. (Claudio Edinger/Corbis)

discovery of endorphins, the naturally occurring substances manufactured in the brain that relieve pain and produce sensations of pleasure.

Thelma Estrin is a bioengineer who pioneered the use of computers in brain research, and **Patricia Goldman-Rakic** is a neurobiologist who mapped the frontal lobe of the brain and combined methods in anatomy, psychiatry, and biochemistry to understand certain brain disorders, behaviors, and the effects of drug treatments for memory loss; Goldman-Rakic also founded and co-edited the journal *Cerebral Cortex*. Nobel Prize winner **Rita Levi Montalcini** is a neurologist who won the Nobel Prize in Physiology or Medicine in 1986 for her discovery of nerve growth factor (NGF), which is responsible for the rapid growth of immature cells implicated in diseases such as cancer and Alzheimer's.

Marian Cleeves Diamond studies the physical structure of the cerebral cortex and the impact of environmental factors (such as diet, exercise, stress, and emotions) on the development of the brain. **Nancy Wexler** holds a Ph.D. in clinical psychology and combined neuroscience and psychology as a neuropsychologist who looked at Huntington's disease, a hereditary disease that kills nerve cells in the brain, causing dementia and rapid, uncontrollable movements of the joints

and limbs. **Susan Hockfield** is a neurobiologist who studies pain and the nervous system—in 2004, she became the first woman (and first life or biological scientist) president of the Massachusetts Institute of Technology (MIT).

Other neuroscientists have contributed to the debate over whether male and female brains are different, looking at the physical structure of brains as well as the effect of hormones and environment, for insight into gendered differences in language, behavior, sexuality, and even math and science aptitude. **Elizabeth Spelke** is a cognitive psychologist whose research focuses on language and knowledge acquisition in young infants; Spelke has been one of the most outspoken critics of the idea of innate gendered differences in the brain, arguing that there are no biological differences between the brains of male babies and female babies. Spelke's colleague, **Nancy Kanwisher**, is a cognitive psychologist who has also argued against innate gender difference; Kanwisher uses neurological research methods and tools to study the various functions of specific parts of the brain as well as the social and evolutionary development of the brain. Psychologist **Susan Carey** also focuses on the brain development of young infants and the acquisition of language and other knowledge.

See also Biochemistry; Biology; Biomedical Sciences; Genetics; Medicine; Psychiatry and Psychology

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Nutrition and Home Economics

Nutrition sciences is the study of human nutritional needs and intake, and their relationship to health, illness, and disease. Nutritional scientists study individual aspects of the human diet and the body's processing of fats, proteins, carbohydrates, vitamins, and minerals. Nutritionists may be trained in biochemistry, pathology, plant biology, microbiology, and toxicology, and may work in fields related to education, community health, medicine and healthcare, government policy-making, and food development, safety, and preparation.

The growing, gathering, and processing and cooking of food has traditionally been the work of women across human cultures. In the nineteenth century, the U.S. government became involved in regulating agricultural production through the U.S. Department of Agriculture (USDA), founded in 1862. Work in food



Chemist and nutritionist Mary Swartz Rose was a pioneer in research on nutrition and dietetics. (National Library of Medicine)

sciences and nutrition was supported and carried out through government land-grant colleges in the Midwest, where women were admitted into programs in animal, agriculture, and household sciences. The USDA subsequently became one of the earliest and largest employers of women scientists. **Mary Engle Pennington**, who earned a Ph.D. in 1895 and was trained in chemistry and botany, worked for the USDA, where she established guidelines for poultry and egg production as well as new methods of killing and transporting chickens; this technology was important for farm productivity as well as for food safety.

It was during World War I, however, that the U.S. government became involved in creating dietary standards, first out of concern for the nutritional

needs of those serving in the armed forces, and then in establishing guidelines for the population at large. Interest in these issues coincided with the entrance of women into higher education and the scientific professions, and with reformers' concerns about the dietary habits of urban families and children. **Frances Stern** applied her dietary research to the needs of the urban poor and immigrants through her internationally recognized Boston Dispensary Food Clinic in the 1920s. Nutrition science was also aided by technological advances in biology and chemistry. The isolation of vitamins and minerals, and research on human vitamin requirements, advanced steadily beginning in the 1920s and 1930s, and by the 1940s and 1950s (again prompted by wartime concerns), the government had established Recommended Daily Allowances (RDA) for various vitamins and minerals, and the idea of food groups and the food pyramid for the general public. Eventually, food packaging was changed to include nutritional information guidelines for consumers.

Many of the first women nutrition scientists focused on the specific dietary needs of women and children. **Mary Swartz Rose** received a Ph.D. in physiological chemistry from Yale University in 1909 and was a pioneer in research on vitamins and minerals. She published several textbooks and popular books for the

public, such as *Feeding the Family* (1916) and *Teaching Nutrition to Boys and Girls* (1932). **Icie Macy-Hoobler**, another Ph.D. in physiological chemistry from Yale (1920), focused on the nutritional needs of pregnant and lactating women, on the connection between nutrition or malnutrition and birth defects, and on infant development and growth; she also served as president of the American Institute of Nutrition in 1944. **Grace MacLeod** (Ph.D., Columbia, 1924) focused on calcium, iron, and other supplements, and on the energy metabolism of children.

Several women nutritional researchers were involved in government efforts to establish the RDA and food guidelines in the mid-twentieth century. **Lydia Roberts** held a Ph.D. in home economics from the University of Chicago (1928), and was a pioneer in the field of children's nutrition, and **Helen Swift Mitchell** was another early physiological chemist (Ph.D., Yale, 1921) who studied vitamins; both women had a key role in development of the RDA. **Hazel Stiebeling** also held a Ph.D. in chemistry (Columbia, 1928) and had a long career at the USDA, where she also helped develop the government dietary guidelines and RDA of vitamins and minerals. **Gladys Emerson** (Ph.D., 1932) was a biochemist who researched amino acids and vitamins and helped isolate vitamin E. **Doris Calloway** earned her Ph.D. in nutrition in 1947 and did research for the U.S. Army on the effect of nuclear radiation on soldiers' rations and later food processing and packaging research for the National Aeronautics and Space Administration (NASA) astronaut program. Others interested in nutrition have launched more popular programs, such as **Jane Brody**, who combined degrees in biochemistry and journalism to become a popular nutrition and personal health columnist, author, and media personality.

Many women nutritionists worked in the field of home economics in the first half of the twentieth century. Catharine Beecher published *A Treatise on Domestic Economy* in 1841, but home economics was established as a profession by a new generation of women with advanced education who combined the social, physical, and natural sciences to elevate the status of household studies in the early twentieth century. The American Home Economics Association (AHEA) was founded in 1908. Home-economics programs included courses in food and nutrition, but also household consumption, management, and budgeting, household technologies, child development, and sewing and textiles. The Bureau of Home Economics was the first USDA department to have a female bureau chief; **Louise Stanley** (who held a doctorate in biochemistry from Yale, 1911) spent over 25 years at the USDA as one of the highest-paid and highest-ranking female scientists in the federal government.

Other women built and directed home-economics programs at major universities. **Agnes Fay Morgan** held a doctorate in chemistry (from the University of Chicago in 1914) and helped build an outstanding scientific research-based

program at the University of California, Berkeley, insisting that chemistry was an integral part of the home-economics curriculum. **Flora Rose** and **Martha Van Rensselaer** founded and co-directed the School of Home Economics at Cornell University. **Abby Marlatt** had a master's degree in chemistry and studied nutrition, and she brought her scientific background and commitments to her work as head of the home-economics department at the University of Wisconsin.

In these early years, home economics was often a place to channel the work and interests of women scientists, who may have been excluded from other departments or programs. In this sense, home economics institutionalized the idea of domesticity as “women’s work.” Its proponents argued, however, that it legitimized household work by deeming it skilled and scientific, and that home-economics training not only took women’s work seriously, but made it more efficient. This was the argument exemplified in the life and career of **Lillian Gilbreth**, a trained psychologist who developed household efficiency studies which she modeled in running her own household of 12 children. Other critics have focused on the ethnocentrism of early nutritional and home-economics reformers, who sought to alter the lifestyles and households of immigrants and the working poor. Several black colleges also offered courses and therefore trained black women as scientists, teachers, and consultants. **Cecile Edwards** held a doctorate in nutrition (1950) and helped establish the program in nutrition at Howard University, but she worked evaluating interdisciplinary programs that provided resources for low-income people around issues of not only nutrition, but also parenting, childcare, household budgeting, and job skills. Still, after the 1950s, home-economics programs were increasingly aimed at female undergraduates who would presumably devote their post-college lives to roles as wives, mothers, and household consumers.

In the late twentieth and now twenty-first centuries, home economics has taken a more international approach. The International Federation for Home Economics (IFHE) focuses its research and practitioners on international development, addressing poverty and malnutrition, and agricultural programs. Such work often requires training and field work in cultural anthropology or politics, as well as language studies, more so than in the natural or biological sciences.

See also Animal Sciences; Biochemistry; Biomedical Sciences; Botany; Chemistry; Economics

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Ocean Sciences

Ocean sciences is one of the earth, atmospheric, and environmental sciences, and includes oceanography and marine biology. Oceanography is the study of the physical nature and processes of the oceans, and includes the chemical, geological, and ecological features of the Earth's oceans, including currents, tides, and ocean weather or climate, underwater landforms and plate tectonics, or the chemical and biological interaction of species and environment. Marine biology is a sub-field of both general biology and oceanography, and focuses on the study of marine life, from the microscopic, to invertebrates, fish, and marine mammals, to plants and algae. Marine biologists use the same methods and tools of the biological sciences, and may focus on cellular or molecular biology, genetics, development and evolution, or the behavior of organisms, or may concentrate on life forms within a particular environment or habitat, such as the ocean floor, the coral reefs, or the open ocean. Marine biology is therefore a scientific field determined by environment or location, rather than by subject or method. The ocean sciences are usually specializations studied at the graduate level, and undergraduate preparation may be in fields such as earth or environmental sciences, biology, or geology.

Covering three-quarters of the Earth's surface, the oceans are often considered the last frontier, and remain less explored by humans than space. The oceans and marine life support human life as a resource for food, medicines, oil, and other raw materials used in a variety of industries and products. The oceans also impact landforms (coastlines, ice formation, etc.) and affect both local weather events and global weather systems and climate change through the system of evaporation, rain, wind, and atmospheric changes. The health of the oceans is crucial to human

life and is thus at the center of global ecological and environmental concerns. The work of oceanographers also informs other disciplines related to use of the ocean's resources, such as engineering, food and pharmaceutical industries, and ocean travel.

The interdisciplinary nature of oceanography led early scientists to develop scientific principles from astronomy, meteorology, and physics, and apply them to the ocean currents and tides system. The history of oceanography thus overlaps with the astronomical and meteorological sciences, and begins with human efforts to observe and track the tides and currents, and chart ocean weather patterns, for purposes of coastal living and maritime travel. The age of exploration took Europeans around the globe, leading to the discovery of new animal and plant species, and science replaced earlier mythologies of sea monsters, mermaids, and mysterious forces ruling the seas. Explorers and coastal inhabitants recorded observations about the shoreline and reef systems. The nineteenth century brought the first efforts to measure the depths of the oceans and chart the undersea geography of cliffs, ridges, and valleys. The accuracy of this work, however, required twentieth-century technology and computer mapping systems.

Oceanography began as a serious scientific endeavor in the late nineteenth and early twentieth centuries, with expeditions focused on geographical and marine biology research to the Arctic and other regions. In the United States, the Scripps Institution of Oceanography (<http://sio.ucsd.edu>) was founded on the west coast, in California, in 1892, and the next major oceanographic research facility, Woods Hole Oceanographic Institution (<http://www.whoi.edu>), was founded on the east coast, in Massachusetts, in 1930. The U.S. government created several agencies focused on scientific ocean research and conservation, beginning with the U.S. Coast Survey (founded in 1807), the U.S. Weather Bureau (1870), and the U.S. Commission of Fish and Fisheries (1871). The U.S. Geological Survey (USGS), founded in 1879, is also involved in oceanographic research; indeed, marine geologist **Marcia McNutt**, formerly director of the Monterey Bay Aquarium Research Institute in California, was named by President Obama as the first female director of USGS in 2009. In 1966, the U.S. government created a National Council for Marine Resources and Engineering Development, and a few years later, in 1970, the National Oceanic and Atmospheric Administration (NOAA) was founded. In 2009, **Jane Lubchenco**, a marine ecologist who researched issues related to global climate change, was also chosen by the president as the first female head of NOAA. In 2008, Woods Hole also named its first female president and director, **Susan K. Avery**, an atmospheric scientist.

There were few doctorates specifically in oceanography before 1960. Oceanographers have studied in many different degree programs and are still included in statistics on the combined earth, atmospheric, and ocean sciences (EAOS).

In 1974, women earned just 4.9% of earth, atmospheric, and ocean science doctorates; by 1999, that number had risen to 27.8%, and it is estimated that in 2001, women earned 38% of all specifically oceanographic doctorates, a number consistent with women's representation across all scientific fields (O'Connell and Holmes 2005). As part of the earth sciences, oceanographers are represented by the same professional organizations, such as the Association for Women Geoscientists (<http://www.awg.org>), and through special programs such as Mentoring Physical Oceanography Women to Increase Retention (MPOWIR) (<http://www.mpowir.org>), sponsored by NOAA and other organizations. The Society for Marine Mammalogy (<http://www.marinemammalscience.org>) represents marine biologists with a specialty in mammals, and other subfields within oceanography and marine biology have their own professional networks and organizations, many of which are international in scope, related to specific regions, organisms, or research concerns.

One of the most renowned American women oceanographers is **Sylvia Earle**, who holds a Ph.D. in botany and has been involved in numerous organizations and projects concerned with observing and preserving marine environments; she was also the first female chief scientist of NOAA. **Kathryn Sullivan** was an astronaut who was trained as a marine geologist and replaced Earle as the next chief scientist of NOAA. **Kathleen Crane** received her doctorate in oceanography at Scripps Institution of Oceanography in 1977 and became the Program Manager in NOAA's Arctic Research Office, leading several U.S.–Russian expeditions to the Arctic. Many oceanographers have been trained in geology and geosciences. **Elizabeth Bunce** was a geophysicist who spent a long career at Woods Hole Oceanographic Institution studying marine seismology and underwater acoustics. **Marie Tharp** studied underwater geology and created some of the first maps of the ocean floor, including her discovery of the valley that divides the Mid-Atlantic Ridge. **Marcia McNutt**, who became director of both the Monterey



Marine biologist Sylvia Earle next to a submersible suit. (Bettmann/Corbis)

Bay Aquarium Research Institute and then USGS, also mapped and measured the depth of the sea floor and researched plate tectonics. **Helen McCammon** is a marine geologist who began her career in marine paleontology, but then began to research living invertebrates and marine ecology. **Joan Owens** is considered the first African American woman to earn a doctorate in geology; she studied marine geology and researched deep-sea button corals.

An earlier generation of women also conducted research on marine ecology, which provides insight into human and planetary health. **Josephine Tilden** earned her master's degree in 1897 and in the early 1900s was a specialist in marine botany and ecology who studied coastal and Pacific algae. **Mary McWhinnie** was a marine biologist and ecologist who studied krill in the ocean food chain; she was one of the first women scientists to winter in Antarctica. **Audrey Haschemeyer** was trained in physical chemistry and was another of the earliest American women to conduct research in Antarctica, where she studied how temperature change affects the biological processes of fish. Renowned ecologist **Rachel Carson** held a master's degree in zoology and began her career as an aquatic biologist at the Marine Biological Laboratory at Woods Hole, Massachusetts, publishing two early books on marine ecology and oceanography: *Under the Sea Wind* (1941) and *The Sea Around Us* (1951). In the 1980s, **Rita Colwell** became a leader in marine biotechnology, concerned with medical, industrial, and aquaculture resources available from the sea; she served as president of the University of Maryland Biotechnology Institute (UMBI).

Marine biologists study animal life in the oceans, work that overlaps with zoology. **Francesca La Monte** did not hold an advanced scientific degree, but worked as an ichthyologist at the American Museum of Natural History for her entire career, between 1919 and 1962; she wrote several books on large marine species, such as marlin and swordfish. **Eugenie Clark** received her Ph.D. in zoology in 1950 and became a world-renowned marine biologist who specializes in sharks and other fishes. **Dixy Lee Ray** was trained as a zoologist and marine biologist who focused on crustaceans, but she became involved in environmental policy and then politics as governor of the state of Washington.

See also Biology; Botany; Environmental Sciences and Ecology; Geography; Geology; Meteorology; Paleontology; Zoology

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Paleontology

Paleontology is the study of ancient (or prehistoric) life forms and geological structures through the Earth's fossil record. The work of paleontologists may depend upon the tools and methods of biology, botany, chemistry, geology, oceanography, and zoology, as well as evolutionary biology, environmental sciences, anthropology, and history. Although archaeology is also the study of the ancient past, archaeology focuses on the material record of the human past, whereas paleontology might also include fossils of rocks, shells, animals, and plants. Paleontology involves fieldwork for specimen collection, and scientific tools for analysis, but shares with the social sciences the attempt to observe and explain phenomena, rather than formulating theories through experiments. Although we tend to think of dinosaurs as the primary subject of paleontologists, some subfields of paleontology are paleobotany, paleoecology, paleoclimatology, paleoceanography, and paleogeography. Paleontologists may also focus on specific types of fossils or species, such as mammals, reptiles, birds, insects, invertebrates, or specific types of plant life forms.

The science of paleontology developed beginning in the eighteenth century, and the first professional scientific organizations and museum collection efforts began in the nineteenth century. The first North American dinosaur fossil was found in 1858, coinciding with the westward expansion of the population in the United States, which promoted new geological discoveries and competitive fossil-collecting expeditions in the late nineteenth century. In the early twentieth century, other scientific advances, tools, and concerns led to new inquiries and new priorities in paleontology. Modern paleontologists use a variety of technologically advanced tools in genetics, biochemistry, and computer science, making possible

computer and DNA analysis and dating of fossils for the study of the chemical and biological origins and evolution of life, and for specific problems such as the extinction of species, historical changes in the Earth's climate and ecosystems, and the origins and dating of Earth itself.

British women made some of the earliest discoveries in paleontology. In the nineteenth century, more women were involved as “amateurs” in fieldwork and specimen collecting, not only in paleontology, but also in natural history, botany, geology, and archaeology. Mary Anning was an early-nineteenth-century British fossil collector and paleontologist who sold fossils to tourists, scientists, and museums for income. Anning discovered the first complete skeleton of an *ichthyosaur* and the first known skeleton of a *plesiosaur*, both sea reptiles, and her contribution was acknowledged by membership in the Geological Society of London and a later pension from the British Association for the Advancement of Science. In the United States, one of the earliest and most significant female fossil hunters was Annie Montague Alexander, who did not hold a science degree but went on several field expeditions in the early 1900s, discovered new species, and donated thousands of animal and fossil specimens to the University of California, Berkeley for their zoology and paleontology museums (Stein 2001).



Paleontologist Tilly Edinger proved that the brain's evolution could be studied through fossils. (Bettmann/Corbis)

In the twentieth century, many women have worked in the field of paleontology, although as with archaeology, geology, or other field-based sciences, they have come up against stereotypes and concerns about women joining in expeditions, working alongside male scientists, and leaving home and family behind. **Carlotta Maury** was one of the earliest professional American women paleontologists, receiving her doctorate from Cornell University in 1902; she specialized in South American geological expeditions and was the official paleontologist of Brazil for 20 years. **Winifred Goldring** did not hold an advanced degree, but she took graduate courses at Columbia, Harvard, and Johns Hopkins University in the early 1900s and became the state paleontologist of New York.

Mary Anning

Mary Anning (1799–1847) was a British fossil collector who made some of the most important marine fossil discoveries of the nineteenth century through exploring the cliffs and fossil beds along the shore near her home in Lyme Regis. She uncovered a complete ichthyosaur skeleton and the first plesiosaur skeletons ever found. Her work changed the nineteenth-century scientific understanding of pre-historic life and extinction, paving the way for Darwin's theory of evolution and for the modern studies of geology and paleontology.

Anning and her brother, Joseph, began by selling shells, rocks, and fossils to tourists at Lyme Regis, inspiration for the later tongue-twister “She sells sea shells by the seashore.” They later opened a storefront where the ichthyosaur skeleton was on display and were soon visited by fossil hunters and museum collectors from across Europe and the United States. As a self-educated woman (she read scientific journals and dissected animals to study anatomy and classification), Anning was always an outsider to the scientific community, but she was able to support herself through the sale of her specimens and through the patronage of those who supported her work. Eventually, one such friend arranged for her to receive a government pension for her contributions to science. Interest in Anning's compelling story continues, as she is the subject of two modern biographies, as well as a novel inspired by her life.

She wrote several books on fossils for the general public and was named the first female president of the Paleontological Society in 1949. **Julia Gardner** earned a Ph.D. from Johns Hopkins in 1911 and was also president of the Paleontological Society in 1952. Gardner studied mollusks found in sedimentary and other rocks and was one of the first women employed by the U.S. Geological Survey. **Katherine Palmer** had a Ph.D. in paleontology from Cornell University (1925) and also studied mollusk fossils; she was president of the American Malacological Union in 1960. **Tilly Edinger** received her doctorate in Germany in 1921 and researched fossils of mammal brains to understand the evolution of the brain; she became president of the Society of Vertebrate Paleontology in 1964. **Christina Lochman Balk** earned a Ph.D. in 1933 and researched invertebrate fossils; she was also a geologist who specialized in stratigraphy, or the analysis of rock layers.

In the post-1960s generation, paleontologists continue to combine work in biology, botany, geology, and environmental studies in a variety of fields and research interests. **Margaret Bryan Davis** is a paleoecologist and plant biologist trained in biology at Harvard University (Ph.D., 1957) who analyzed ancient pollen and

vegetation and has taught in departments of ecology and evolution. **Estella Leopold** is also a paleoecologist and botanist who received her Ph.D. in botany from Yale University in 1955 and has studied ancient environments through the pollen and spore fossil record. **Helen Loeblich** earned a Ph.D. in geology from the University of Chicago in 1942, and was another plant paleontologist whose research focused on living and fossil plant microorganisms. **Pat Shipman** has combined paleontology and archaeology (she holds a doctorate in anthropology from New York University, 1977) to understand how ancient humans evolved and interacted with their physical environments.

Women paleontologists are represented by professional organizations according to their subspecialties (botany, geology, or zoology, for example), or by broad groups such as the Paleontological Society (<http://www.paleosoc.org>), the Society of Vertebrate Paleontology (<http://www.vertpaleo.org>), or the Society for Sedimentary Geology (<http://www.sepm.org>). In many cases, the fieldwork and research of paleontologists is international in scope and is carried out throughout the globe, and in cooperation with professional societies, institutions and governments in other countries.

See also Anthropology and Archaeology; Biology; Botany; Geology; Zoology

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Pharmacology

See Biochemistry; Biomedical Sciences; Botany; Chemistry; Medicine

Physics

Physics is the science of the physical properties and laws of matter, energy, force, time, and motion. In broadest terms, physics is an attempt to understand the principles or laws of the natural world and the universe. As such, it is grounded in natural philosophy as much as in scientific observation and experimentation. Physics relies upon and also informs work in mathematics, engineering, chemistry, and astronomy. Physics results in the creation of new theories about the natural world as well as new technologies. Because of this comprehensiveness and

Marie Curie

Perhaps the most well-known woman scientist, Marie Skłodowska Curie (1867–1934) is the only woman (and one of the few scientists) to win two Nobel Prizes. For her work on radium, she shared the Nobel Prize in Physics in 1903 with her husband, Pierre Curie, and with Antoine Henri Becquerel, the discoverer of radioactivity; Marie Curie went on to win a second prize, the Nobel Prize in Chemistry, in 1911. The Curies developed techniques for isolating radioactive isotopes, and discovered two new chemical elements: radium and polonium, named for Marie Curie's native country of Poland. During and after World War I, Marie Curie (along with her daughter Irène Joliot-Curie, who also later received a Nobel Prize) dedicated her research to medical uses for radium and radiography in treating wounded soldiers.

Born in Warsaw, Poland, Marie Curie studied physics and math at the Sorbonne in Paris, France, where she met and married Pierre Curie. She received her doctorate in 1903 and later took her husband's place as Head of the Physics Laboratory, and was the first woman appointed Professor of General Physics at the Sorbonne. In 1914, she became director of the newly founded Curie Laboratory in the Radium Institute of the University of Paris, and later founded the Radium Institute in Warsaw. A *curie* is now a scientific term for a unit of radioactivity.

breadth of inquiry, physics has a long history and developed along with discoveries in chemistry, mathematics, and astronomy. Physics began as a distinct discipline with the experiments and observations on motion, mechanics, and space of individuals such as Galileo Galilei and Isaac Newton in the seventeenth century. By the late nineteenth and early twentieth centuries, more abstract theories about the natural world were formulated based on scientific discoveries in mechanics, magnetism, sound, light, and electricity. The discovery of X-ray radiation and the atom led to the development of crystallography and atomic physics as subfields of physics. One of the most famous women scientists, Marie Curie of France, won Nobel Prizes in both Physics (1903) and Chemistry (1911) for her theory of radioactivity and for her isolation of radioactive isotopes.

One of the earliest American women physicists was **Margaret Maltby**, who was an undergraduate at the Massachusetts Institute of Technology but went on to earn her Ph.D. from the University of Göttingen in 1895. Maltby's areas of research included radioactivity and the physics of sound. She taught courses in chemistry and physics to female students at Barnard College for more than 30 years. **Elizabeth Laird** was another one of the earliest professional female physicists in the United States, earning her Ph.D. in physics and mathematics from Bryn Mawr in 1901. Laird went on to train an entire generation of women in the

Women and the Manhattan Project

The Manhattan Project was the U.S. government's secret project to develop nuclear weapons during the early years of World War II. The government employed military and civilian scientists to research and develop three atomic bombs. Many women scientists and engineers were involved in various stages of the project, many of them through the Women's Army Corps (WAC), but others were scattered as civilians at government research centers and universities throughout the country as physicists, chemists, engineers, mathematicians, biologists, medical researchers, technicians, and machine operators. Nuclear science, and the development of nuclear power, was an exciting new field in the early decades of the twentieth century, and not all scientists involved in the project supported or fully understood the military intentions for a bomb. Some of the highest-level female physicists of that generation were involved in the project, including later Nobel Prize winner **Maria Goeppert-Mayer**, **Leona Woods Marshall Libby**, **Chien-Shiung Wu**, and **Katharine Way**, who eventually joined with other scientists in addressing the ethical uses of and concerns about nuclear power.

sciences during her 40-year career at Mount Holyoke College. During World War II, she returned to her home country of Canada as a physicist in radar development and radio techniques for the Royal Canadian Air Force. **Dorothy Nickerson** was a physicist who applied color-graded standards to agricultural and horticultural products and soil; she developed the Nickerson color fan of more than 300 color samples graded by light value, hue, and chroma, and had a long career with the U.S. Department of Agriculture beginning in the 1920s.

By the mid-twentieth century, there was a great demand for physicists in the United States and the development of several specialized subfields for particular industries and government/military applications, including optics, astrophysics, geophysics, physical chemistry, materials engineering, and nuclear physics. Many women worked for the U.S. government on various aspects of the atomic bomb project during and after World War II. American scientist **Maria Goeppert-Mayer** was the second woman to win the Nobel Prize in Physics; she was co-recipient of the prize in 1963 for her work on the structure of atomic nuclei. **Katharine Blodgett** earned her Ph.D. in physics in 1926 and spent her entire career in industry, working for General Electric, and her work contributed to two world wars; her early research on the ability of activated charcoal to absorb gases was important to the design of gas masks during World War I, and during World War II she researched ways to de-ice airplane wings and developed a method for military weather balloons to measure air humidity. Several women were directly

involved in the Manhattan Project, the U.S. government project to develop the atomic bomb. **Katharine Way** worked at the Naval Ordnance Laboratory and the Oak Ridge National Laboratory, and also worked in atomic physics for the National Bureau of Standards and the National Research Council; she later joined with other prominent scientists to warn of the ethical considerations of developing and using the atomic bomb. **Chien-Shiung Wu** was one of the top women in elementary particle physics in the world in the mid-twentieth century; she helped develop sensitive radiation detectors for the atomic bomb project.



Physicist and electrical engineer, Elsa Garmire. (Courtesy of Dartmouth/Kathryn LoConte)

The post–World War II generation of women earning doctorates in physics have worked in academia, government and industry on a variety of applications. **Mildred Dresselhaus** is a physicist renowned for her research on electronic properties of materials such as semiconductors and semimetals. **Doris Kuhlmann-Wilsdorf** is a metallurgist and materials scientist who holds patents on six inventions related to electrical brushes for machines and engines, and **Elsa Garmire** holds 10 patents for her work in laser and optical research. **Betsy Ancker-Johnson** was a solid-state physicist who spent many years at General Motors as vice president in charge of environmental policy and was one of the early advocates for more fuel-efficient cars. **Esther Conwell** was head of research departments at both GTE and Xerox, and **Diana Prichard** conducts research on fundamental photographic materials as a research scientist for Eastman Kodak Company. **Caroline Herzenberg** used spectrometry to analyze the first lunar samples returned to Earth from the Apollo missions. **Shirley Ann Jackson** achieved many firsts in physics: In 1973, she was the first African American woman to receive a doctorate in any field from the Massachusetts Institute of Technology, and she was the first woman and the first African American to serve as chair of the federal Nuclear Regulatory Commission (NRC). In 1999, Jackson was appointed president of Rensselaer Polytechnic Institute.

Other physicists have worked in medical and bioengineering fields. **Rosalyn Yalow** was a physicist and neuroendocrinologist who helped establish modern biomedical physics; she was co-recipient of the Nobel Prize in Physiology or

Lise Meitner

Austrian-born physicist Lise Meitner (1878–1968) made great advances in the new field of nuclear physics and collaborated on the discovery of nuclear fission, for which her colleague Otto Hahn won the Nobel Prize in Chemistry in 1944. Meitner attended the University of Vienna and in 1905 was only the second woman to receive a doctorate from that institution. She went on to study with Max Planck in Berlin and then formed a research group with Hahn at Kaiser Wilhelm Institute, where they began their work on radioactive isotopes, work that would eventually lead to the creation of nuclear weapons. The Jewish Meitner was forced to emigrate to The Netherlands in 1938 to escape the Nazi takeover of Austria, eventually finding a position in Stockholm. Although she continued her research through correspondence (and even secretly meeting) with Hahn and others, and published her own paper in the journal *Nature* explaining the physics of nuclear fission, her exile meant that Hahn was acknowledged separately for his chemical research and Meitner was overlooked by the Nobel Prize committee. Twenty years later, colleagues Meitner, Hahn, and Fritz Strassmann were co-recipients of the prestigious Enrico Fermi Award of the U.S. Department of Energy.

Medicine in 1977, the second woman to win in that category. **Eugenie Mielczarek** is known for her work in biophysics, and researches metal and biological compounds, including iron in the blood. Women have contributed to the profession of physics in other ways. **Mary Warg**a received her doctorate in spectroscopy in 1937. After a distinguished career in teaching and research, Warg served the physics profession during a period of rapid growth and technological development for many years as the first executive secretary of the Optical Society of America. **Gloria Lubkin** held a master's degree in physics and contributed to the profession in her 40-year career as editor of *Physics Today*, the publication of the American Institute of Physics.

Despite the early gains made by a first generation of women physicists before and through the 1940s, there was a marked decrease in women's presence in physics during the 1950s, when gender roles became more fixed and scientific disciplines more specialized and prestigious. Despite the astonishing accomplishments and significance of a few individual women, the representation of women in physics throughout the twentieth century was one of the lowest of all sciences, and the lowest of the physical or "hard" sciences (physics, chemistry, astronomy, and math). In 1972, women earned just 3% of doctorates in physics; by 2003, women earned 22% of the bachelor's degrees awarded in physics and just 18% of physics

Ph.D.s (Ivie and Ray 2005). In 2006, women made up 12% of all physics faculty, but only 6% of full professors; many physics departments still have no women faculty at all (Ivie 2006).

Although there are so few women in physics (and in the physical sciences in general, compared to the biological and social sciences), the view that physics is a neutral or hard science has protected the field from much feminist analysis or critique. As with mathematics, there is also a widely held belief that success in the highest levels of the field depends as much upon talent or innate “genius” as upon education or training. Physics does, in fact, rely heavily on theoretical abstraction and interpretation as much as on the scientific laws of objects; in other words, physics involves on some level dealing with *metaphysics*, and physicists often talk about “the face of God,” “the God particle,” or “the mind of God” in their work (Wertheim 1995). As feminist historian of science Londa Schiebinger has characterized the discipline, physics is often held apart from other scientific endeavors in part because it takes as its goal nothing less than “the mastery of the whole world” (Schiebinger 1999, 162). Indeed, physics is often considered the most difficult and therefore the most prestigious of the sciences. As is often the case, the more prestigious the field, the more hierarchical the profession, and the fewer women are represented.

See also Astronomy and Astrophysics; Chemistry; Crystallography; Engineering; Mathematics

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Plant Sciences

See Botany

Primateology

Primateology is the study of the biology, behavior, and evolution of nonhuman primates. As the study of animals, primatology is related to zoology, but also often overlaps with and directly informs studies of human biology and behavior in fields such as anthropology, biomedical research, genetics, psychology, and evolutionary biology. Primatology began as a separate field of study inspired by the work of Charles Darwin in the mid-nineteenth century and an interest in the behavior, communication, habitats, and evolution of humankind's closest relatives. This interest was combined with the development of anthropology as a scientific discipline, and shares many of the same methods and tools. Primatologists work in laboratories, in zoos or other captive habitat settings, and in the wild or natural habitats in Africa, South America, or other locations. There are several major primate research centers in the United States, both university-affiliated and privately run.

Women have featured prominently in primatology since the 1960s, including as some of the most famous primatologists of the twentieth century. A trio of women were influenced and trained by famed British archaeologists and anthropologists Louis and Mary Leakey: British researcher Jane Goodall is perhaps the most well known for her work with chimpanzees, German-Canadian Birute Galdikas is an authority on orangutans, and American **Dian Fossey** devoted her life to the study and protection of mountain gorillas. These scientists pioneered the study of primates as individuals and as members of complex social and familial networks, applying the tools of human-based studies in anthropology, psychology, and sociology.

Since the 1970s, so many women have entered into primatology that it has been perceived as a "women's" field. Whereas no women held doctorates in primatology before 1960, by the 1990s, women earned nearly 80% of Ph.D.s in primatology (Schiebinger 1999, 126). One explanation for women's predominance in this field is that primatology is a relatively new field and so women did not face

Birute Galdikas

Birute Marija Filomena Galdikas (b. 1946) is a German-born primatologist and ecologist who is the world's leading authority on the orangutan, now an endangered species due to poaching and habitat destruction. She is president of the Orangutan Foundation International (<http://www.orangutan.org>) and since 1971 has served as head of the orangutan research station at Tanjung Puting Reserve in Borneo. Galdikas is one of three pioneering women primatologists of the twentieth century, along with Jane Goodall and Dian Fossey, who worked with anthropologist Louis Leakey to study the three major primate groups—the gorilla, the chimpanzee, and the orangutan. The work of these women changed the methods by which primatologists conduct research by studying animals as individuals, with life and family histories.

Galdikas's family fled Europe after World War II and emigrated to Toronto, Canada. She began her studies at the University of British Columbia, but then transferred to the University of California, Los Angeles. She met Leakey when he spoke to one of her graduate anthropology classes, and she volunteered for his project of studying wild orangutans in Borneo and rehabilitating those illegally held in captivity. Her research on orangutans became a lifetime commitment, for the animals have a life span of 50 to 60 years. Galdikas has been profiled in numerous articles, books, and television shows. Her autobiography is *Reflections of Eden: My Years with the Orangutans of Borneo* (1995).

historical bias in the profession. Another explanation, however, is that primatology is closely related to other fields in which women also have significant representation, such as anthropology, psychology, or other animal sciences. Finally, it must be acknowledged that high-profile women such as Jane Goodall (who has also launched a successful global education campaign) provide strong role models for young girls and women considering scientific professions, and have interested many in primatology (Fedigan 1994).

The work of primatologists has had a significant influence on our understanding of gender roles and biases among humans as well. Primatologists begin by rejecting the idea that human assumptions and social roles apply to the animal world, and instead look at the ways the lives of the great apes inform our understanding of human development and evolution. Female primatologists have also often shifted the focus of scientific research to female primates as subjects of study, focusing on individual behavior, sexuality, family groups, and care of offspring. They have uncovered greater roles for female primates beyond stereotypical submissive child-bearers and thus have called into question the idea of a “natural” sexual division of labor or submissive sexual or maternal roles among humans as well. For more than



Anthropologist and primatologist, Meredith Small. (Courtesy of Cornell University)

40 years, **Jeanne Altmann** has studied the impact of genetics, demography, and behavior on issues such as mate choice and care of offspring among baboons in the wild. **Meredith Small** also studies mating and childrearing among primates, and her research has informed her several popular books and articles on human behavior and evolutionary biology, especially on the topic of mothering. **Sarah Blaffer Hrdy** is also an evolutionary biologist and primatologist who has written several controversial works on infanticide among primates, on gender and evolution, and on motherhood.

See also Anthropology and Archaeology; Biology; Biomedical Sciences; Genetics; Paleontology; Psychiatry and Psychology; Zoology

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Psychology and Psychiatry

Psychology and psychiatry are applied sciences that rely upon both qualitative and quantitative tools and methods for the scientific study of the human mind. Psychology is the analysis of human behavior, personality, perception, emotions, and cognition, and seeks to understand both the conscious and unconscious motivations behind responses to social and individual situations and relationships. Psychologists may address issues related to family life, child development, sexuality, life stages, transitions, choices, and so forth, as well as mental-health issues such as depression, anxiety, or fears. A professional psychologist usually holds a Ph.D., but some therapists may hold a master's degree or other certification in psychology, social work, or counseling. Psychiatry combines the behavioral, social, and medical sciences to understand behavior and mental health, including mental disorders and diseases. A psychiatrist has completed medical training for the M.D. degree and may prescribe drugs to patients; she may also hold a Ph.D. Psychiatric specialties include cognitive or developmental psychology, neuroscience and brain research, psychometrics (quantitative analyses such as educational, intelligence, or aptitude testing), psychopathology, and psychotherapy. Both psychologists and psychiatrists may also specialize in a particular subset of patients (such as women, children, adolescents, or gays and lesbians) or on particular issues, and may be employed in a variety of settings, including academic research, private therapy practice, hospitals, mental-health facilities, schools, corporations, or other institutions.

Early studies of human behavior were encompassed within the field of philosophy. It was not until the mid-nineteenth century that psychology developed as a separate scientific field of study; in the United States, William James is often considered the founder of modern American psychology. The American Psychiatric Association (<http://www.psych.org>) was founded in 1844 and the American Psychological Association (<http://www.apa.org>) in 1892. Mary Whiton Calkins was the first female president of the American Psychological Association in 1905, and the second was **Margaret Floy Washburn** in 1921. The gender bias that limited women's opportunities throughout the sciences, however, was justified by the new psychological science, with male psychologists warning that women were intellectually inferior and that "mental exertion" was damaging to women's health. Psychologist and neurologist **Helen Thompson Woolley** (who published a book, *The Mental Traits of Sex*, in 1903) voiced the frustrations of a woman scientist at that time in her 1910 review of the psychological literature, concluding, "There is

Dorothea Dix

Dorothea Lynde Dix (1802–1887) was a reformer and nurse who is best-known for her work organizing and training volunteer nurses during the American Civil War. Dix began her career as a teacher, but her own poor health forced her to give up teaching and focus on writing instead. She published a science textbook as well as stories for children. She traveled to London and was introduced to the ideas of prison and health reformers, convincing her to visit prisons back in the United States to examine the terrible conditions under which the “insane” were kept. She enlisted the help of other prominent Massachusetts reformers to expose the abuse, starvation, and torture of the mentally ill, leading to the establishment of the Worcester Insane Asylum (later the Worcester State Hospital), the first institution of its kind. Dix then took the campaign to establish mental health hospitals to other states and to Canada, Japan, and Europe. In 1861, she served in an official military role as superintendent of nurses for the Union Army. She spent the final years of her life living on the grounds of the New Jersey State Hospital.

perhaps no field aspiring to be scientific where flagrant personal bias, logic martyred in the cause of supporting a prejudice, unfounded assertions, and even sentimental rot and drivel, have run riot to such an extent as here” (Benjamin 2007, 178).

In the twentieth century, the views of thinkers such as Sigmund Freud (who defined women’s primary mental state as one of jealousy of men) came to define psychological theories about women for several more generations. Still, women made great inroads into the profession, and early female psychologists created new research fields related to women’s education, motherhood, and child welfare. **Leta Stetter Hollingworth** received her Ph.D. in 1916 and was a pioneer in the psychology and education of women and children; like Woolley, she found that there was no differences between the sexes when it came to intellectual ability. **June Etta Downey** (Ph.D., 1907) developed one of the earliest scientific personality tests to assess character traits separate from the question of intelligence, and **Florence Goodenough** (Ph.D., 1924) conducted early research on intelligence testing in children. In the next generation, **Eleanor Gibson** (Ph.D., 1938) also focused on learning and perception in young children, and **Eleanor Maccoby** (Ph.D., 1950) continued the work on intelligence tests and the developmental and social psychology of young children as related to gender differences.

Women psychologists in academia have taught in departments of psychology or sociology, political science, education, child development, and home economics, but psychologists are also employed in schools, childcare centers, government and policymaking institutions, industry, and hospitals. By 1940, women made up

only 26% of college and university faculty in psychology, but they accounted for 51% of employed psychologists in schools, clinics, and counseling and mental-health centers (APA “Appendix A”). Women received 23% of U.S. doctorates in psychology from 1920 to 1974 (APA “Women in Academe”), but there was a striking racial difference, as most of these were white women. In roughly that same era of growth, between 1920 and 1950, only eight black women earned Ph.D.s in psychology or Ed.D.s in educational psychology (out of a total of 32 African Americans earning doctorates in psychology) (APA “Appendix A”). The first of these was Inez Prosser, who earned an Ed.D. from the University of Cincinnati in 1933, but whose career was cut short by her early and tragic death. The following year, in 1934, **Ruth Howard-Beckham** became the first black woman to earn a Ph.D. in psychology. Few black women overall earned higher degrees in psychology, and few had careers in academia, until after the 1970s.

Psychology now accounts for the highest numbers of doctorates awarded each year in *any* field, and is the one scientific field in which women, since the 1960s, have earned an overwhelming majority of degrees granted. In 2006, women earned 77% of bachelor’s degrees in psychology (NSF Table C-14) and an astonishing 71.3% of doctorates (NSF Table F-2). In sheer numbers, only the biological or life sciences account for more doctorates to women, but in those fields, men still earn about half of the degrees awarded.

Since the 1970s and 1980s, women have worked within a variety of psychological research fields, overlapping with work in industrial psychology (**Lillian Gilbreth**), linguistics (**Lila Gleitman** and **Barbara Partee**), the anthropology and sociology of death (**Elizabeth Kübler-Ross**), addiction (**Judianne Densen-Gerber**), disability (**Phyllis Harrison-Ross**), counseling and social work (**Carolyn Payton**, who served as director of the Peace Corps), neuroscience (**Nancy Kanwisher** and **Elizabeth Spelke**), and the human relationship to computers (**Sherry Turkle**). Other popular psychologists have become well-known media figures, such as **Joyce Brothers** and



Psychiatrist Elisabeth Kübler-Ross, 1970. She specialized in the study of the experience of dying and death. (AP/Wide World Photos)

Ruth Westheimer. Both Brothers and Westheimer focused on family, relationships, and sexuality, as did **Virginia Johnson** in her work on sexual behavior and **Elaine Hatfield** in her studies on love, sex, and choices of marital partners.

Like medical researchers, psychologists and psychiatrists also address the question of women as subjects or patients. Therapists and researchers deal with a range of issues of concern to women as patients, and research topics include family life, depression, sexuality, domestic violence, sexual abuse, gender identity, parenting, marriage, lifespan issues, transitions, career issues, and trauma and grief counseling. The Society for the Psychology of Women (a division of the APA, <http://www.apa.org/divisions/div35>) was founded in 1973 as “a voice of feminist issues within organized psychology.” The division publishes a newsletter, *The Feminist Psychologist*, and compiles biographical information on important women in psychology. The Association for Women in Psychology (<http://www.awpsych.org>) was co-founded in 1976 by **Phyllis Chesler**, not just as a source for professional networking, but with an explicitly feminist approach to psychological and psychiatric practice and education.

Some feminist psychologists, such as Chesler and **Naomi Weisstein**, have critiqued the psychological definition of *femininity* itself as a form of mental illness; that is, the tendency to characterize all women as submissive, docile, and overly emotional. Whether it is barrenness, pathological sexual desire (which could be anything from lesbianism to too much interest in sex), or pathological mothering, women’s mental state and stability has often been explicitly connected with sexuality and reproduction; even the word *hysteria* is derived from *the womb*. Current research shows that women are more likely than men to suffer from mental-health disorders, including anxiety, depression, eating disorders, and social phobias. Studies in the mid-1990s found that women were twice as likely as men to suffer from depression, and that female patients received 70% of prescriptions for antidepressant drugs (APA “Briefing”). The question is whether women are being misdiagnosed due to gender bias, or whether there is, indeed, an epidemic of female depression and other ailments as a response to gender role expectations, sexual or physical abuse, the stresses and isolation of mothering, or a lack of fulfillment in the lives of modern women (see also Caplan and Cosgrove 2004).

Feminist practitioners and researchers have tried to separate the biological or medical issues from the psychosocial causes of women’s mental-health concerns. For example, research in the late twentieth century found that while the psychological effects of stress, role expectation, isolation, and discrimination affect women’s mental health, conditions such as premenstrual syndrome (PMS) or postpartum depression have a biological or chemical component that needs to be taken seriously as a medical issue. Women are still told that their illnesses and symptoms are “all in their

head,” leading to misdiagnosis and lack of treatment for diseases that have come to be associated with women, such as lupus, chronic fatigue, and even some allergies.

See also Anthropology and Archaeology; Neuroscience; Sociology

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Sociology

Sociology is the scientific study of human interactions and social organization, and may be informed by or based in research in other quantitative social science fields, such as political science, anthropology, psychology, economics, or

medicine and public health. Topics of focus for sociologists may include gender, sexuality, race or ethnicity, workplace, family, healthcare, the media and popular culture, religion, the military, prisons, or schools, to name a few. Historically, sociological inquiry was encompassed within philosophy and political philosophy, which sought to understand the nature of human interactions and society. The late eighteenth and early nineteenth centuries brought massive social changes in the form of industrialization, migration, urbanization, poverty, and the democratization of politics and religion. Like other scientific disciplines, sociology was professionalized as a separate field of study in the late nineteenth century; the first sociology courses were taught in the 1890s, and the *American Journal of Sociology* was founded in 1895. The American Sociological Association was founded in 1905. Sociologists may work in academia, or in a variety of positions in social work, nonprofits, politics, business, and media or communications.

The feminist movement of the 1970s and 1980s brought new questions and new methods to sociology, similar to the critiques and changes made in anthropology, psychology, or other social sciences. By the late 1970s, many colleges and universities were offering new courses in the sociology of women and, indeed, sociology and sociological theory often serve as the foundation or core of interdisciplinary Women's and Gender Studies programs and departments. Professional groups specifically for women sociologists or sociologists of women's issues include Sociologists for Women in Society (<http://www.socwomen.org>), which also publishes a journal, *Gender and Society*, and the American Sociological Association's (ASA) Committee on the Status of Women in Sociology (<http://www.asanet.org/about/statuscommittees/women.cfm>).

As in the field of psychology, women have earned a majority of undergraduate degrees in sociology since the mid-1960s and, since the 1980s, women have consistently earned as high as 70% of sociology bachelor's degrees. The rate at which women have earned sociology doctorates, however, has been slower but more dramatic, with women earning only 16% of Ph.D.s in 1966 but 59% of Ph.D.s by the year 2000. It is difficult to trace a direct connection between undergraduate and graduate study, however, as many students may see a sociology bachelor's degree as a terminal degree, or as a foundation for graduate work in other social or natural science fields. Those who go on for a doctorate in sociology overwhelmingly work in academia; only 17% of new sociology Ph.D.s in the early 2000s were employed in nonacademic positions, and 8 out of 10 ASA members in 2001 were employed in academic teaching positions (CSWS 2009).

Feminist sociologists incorporate race, ethnicity, class, and gender into research on issues that affect women, such as motherhood, work/life balance, the household division of labor, poverty, welfare reform, childcare, gender

discrimination in the workplace and society, sexual harassment, the law, sexuality, LGBT (lesbian, gay, bisexual, and transgender) issues, illness, and aging. **Maxine Baca Zinn** conducts sociological work on Latino families and Mexican American women. **Jacquelyne Jackson** earned her Ph.D. in 1960 and has conducted research and created a documentary film on minority aging and the needs of elderly African Americans. **Matilda Riley** was an earlier-generation female sociologist (receiving a master's degree from Radcliffe College in 1937) and was also an authority on aging and on the need for employment opportunities and meaningful work for the elderly. Other sociologists have focused on work and the workplace. **Rosabeth Kanter** studied the human aspects of corporate culture, management, and job performance. **Dorothy Nelkin** did not hold an advanced degree (she received a B.A. in sociology from Cornell University in 1954), but she became a researcher and eventually a faculty member at New York University studying workplace safety and risk assessment in a variety of occupations.

Barbara Reskin was inspired by the women's and civil rights movements at the time she received her doctorate (in 1973) to study sexual and racial inequality in the workplace, including issues of racial and gender segregation, discrimination in hiring and promotion, and work/life issues for female professionals (including women scientists). **Jane Ava Menken** received her Ph.D. in 1975 and combined her background in mathematics and statistics as a demographer who interprets numbers and trends related to government policy and reproductive rights. **Sherry Turkle**, also of this generation (receiving her Ph.D. in 1976), combined interests in sociology and psychology in her pioneering research on human interactions with computers and how computer use shapes our identities and behavior.

See also Anthropology and Archaeology; Economics; Geography; Psychology and Psychiatry



Demographer and sociologist, Jane Ava Menken. (Courtesy of the University of Colorado)

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Zoology

Zoology is the biological study of animals and their physical characteristics, behavior, and evolution. Modern zoology is a broad field that overlaps significantly with various subspecialties within biology, and with interdisciplinary studies in the ecological, environmental, and evolutionary sciences. Zoologists may also focus on specific groups or species of animals, such as invertebrate zoology, entomology (insects), ichthyology (fish), herpetology (reptiles), ornithology (birds), mammalogy (mammals), primatology (nonhuman primates), and subfields or specialties within those groups. Because of the broad term of "zoology" applied to this range of fields and research topics, many early women zoologists were identified as biologists, naturalists, or specimen collectors and museum curators. Modern zoology begins with the classification and naming (taxonomy) of plants and animals under Carl Linnaeus's system in the eighteenth century. Linnaeus, a Swedish botanist, introduced the system of assigning a genus and a species name to every living organism. In the nineteenth century, naturalist and conservation efforts led to the creation of the first zoos and zoological societies. Charles Darwin's theories of adaptation and evolution in his *On the Origin of Species* (1859) also had a major impact on zoological research and taxonomy, and technological and scientific advances (such as in genetics and cell biology) set the course for zoological research in the twentieth century.

In the twentieth century, zoology became a popular field of study for women in the sciences. In 1938, a survey of employed scientists listed more women in zoology than any other discipline (followed closely by botany as the second choice). The greatest number of these pre-1940 female zoologists were employed at two women's colleges, Wellesley and Mount Holyoke, even though the greatest number of women holding doctorates in zoology had been trained in programs at the University of California, Berkeley and at Columbia University in New York (Rossiter 1982, 170, 184). **Ethel Harvey** received her Ph.D. from Columbia in 1913 and made significant breakthroughs in cell biology with her research on sea urchins. **Libbie Hyman** received her Ph.D. in 1915 from the University of Chicago and published several zoology textbooks and a multivolume work on invertebrates; she was elected president of the Society for Systematic Zoology in 1959. **Alice Boring** (Ph.D., Bryn Mawr, 1910) was a zoologist who spent most of her career in China

Maria Sibylla Merian

German-born Maria Sibylla Merian (1647–1717) was a naturalist and scientific illustrator who became well-known for her detailed studies and drawings of plants, flowers, and insects. One of the first naturalists to study insects firsthand, she made important early contributions to the field of entomology, informing the later classification efforts of Carl Linnaeus. She published several books of nature and plant drawings, and, in 1679, already the mother of two daughters, she published her work on *The Caterpillar, Marvelous Transformation and Strange Floral Food*. This was the first work to trace the development of caterpillars into butterflies, with detailed information on their plant food needs at each stage. Living primarily in Amsterdam, in the early 1700s, Merian traveled to the Dutch colony of Suriname with her daughter, where she recorded notes and sketches of local plant, animal, and insect life, and collected specimens to study and sell back in The Netherlands.

Although Merian's work was groundbreaking, and her books were popular and sold well, she was not always acknowledged by the male scientific community because she did not publish in Latin. Still, several species of plants and insects were named in her honor, and her beautiful botanical illustrations and engravings have been enjoyed by students of science as well as art.

and made significant contributions to the literature on the taxonomy of Chinese amphibians and reptiles. **Hope Hibbard** also earned a doctorate from Bryn Mawr (1921) and was a cell biologist who conducted early tissue studies of marine invertebrates. **Roger Arliner Young** researched sea urchin eggs and other organisms, and was the first African American woman to earn a degree in zoology (from the University of Pennsylvania in 1940).

Ornithology, especially, seemed to be an outgrowth of women's early interest in nature observation and wildlife preservation. **Florence Bailey** did not hold an advanced degree, but published several books on natural history, wildlife, and birds in the late nineteenth and early twentieth centuries. **Frances Hamerstrom** held a master's degree in wildlife biology and wrote several popular books, children's books, and autobiographies about her work observing the habitats of ground birds and birds of prey. **Margaret Nice** was trained in psychology and extended her work to the study of the behavior of birds. Other zoologists also combined their research on animals with not only species-preservation efforts but also environmental and ecological messages about the interrelationship between human and animal species and habitats. **Ann Haven Morgan** (Ph.D., 1911) studied the biology and ecology of freshwater animals and insects. Renowned ecologist



Ornithologist, Margaret Morse Nice, 1944. She adapted the scientific techniques of psychology to new research on bird behavior. (AP/Wide World Photos)

Rachel Carson held a master's degree in zoology (from Johns Hopkins in 1932) and began her career as an aquatic biologist. **Lucille Stickel** earned her Ph.D. in zoology in 1949 and was a pioneer in the study of pesticides and chemical residues found in animal brain tissue.

Women were also prominent in entomology in the early twentieth century. **Isabel McCracken** was an entomologist and zoologist (Ph.D., Stanford, 1908) who conducted research and published scientific papers on the genetics of beetles and on birds of the Sierra Nevada mountains. Entomologist **Annette Braun** (Ph.D., University of Cincinnati, 1911) and her sister, botanist **Lucy Braun**, combined their scientific interests on joint research expeditions and preservation efforts. **Edith Patch** (Ph.D., Cornell, 1911) studied the life histories and ecology of migratory aphids, and in 1936 was elected the first female president of the Entomological Society of America. **Elizabeth Peckham** was an early entomologist

who, in collaboration with her husband, had a significant career researching the social lives of wasps before returning to earn her doctorate later in life; she earned a Ph.D. from Cornell in 1916 at the age of 62. **Bertha Cady** also earned her Ph.D. later in life, receiving a doctorate from Stanford University in 1923 at the age of 50; Cady was trained as an entomologist, but her research and teaching interests included natural history and psychology.

In the later twentieth century, women entomologists continued to contribute to scientific research and to apply their studies to problems in agriculture and other industries. **Mary Jane West-Eberhard** is a renowned entomologist who has studied the evolution of social behavior of paper-wasps and other insects, primarily in Central and South America. Entomologist **May Berenbaum** has focused on the unexplained reductions in the honey bee population in the early twenty-first century, launching a public campaign to highlight the importance of bees not only for supplies of honey and wax, but for pollination of other plants, flowers, and food crops. **Marjorie Hoy** is an entomologist who pioneered the development of new methods for insect control in food crop plants.

Other zoologists focus on specific large animal species. **Francesca La Monte** did not hold an advanced degree, but spent her entire career as an ichthyologist at the American Museum of Natural History researching and developing exhibits on marlin, swordfish, and other species. **Eugenie Clark** holds a Ph.D. in zoology and has specialized in sharks. **Cynthia Moss** is a renowned wildlife biologist who is an expert on the African elephant; with colleague Joyce Poole (who holds a Ph.D. in animal behavior) she has also led the fight to stop the world trade in ivory. Primatologists may be trained in zoology or in specialized fields, such as animal behavior and development. **Jeanne Altmann** and **Dian Fossey** are both primatologists who have also combined scientific research with public education and preservation efforts to protect the large primates from poaching and habitat destruction.

Finally, the work of many zoologists and animal biologists has informed medical research on human health and disease. **Florence Peebles** was one of the earliest cell biologists and zoologists (Ph.D., Bryn Mawr, 1900); her work on the embryology of chicks informed tissue-regeneration research in both plants and animals. Early zoologist **Elizabeth Adams** received her Ph.D. in 1926 and taught some of the first courses in heredity and in human embryology and the reproductive system. **Margaret Lewis** was an embryologist and zoologist who worked in the early decades of the twentieth century on *in vitro* mammalian tissue cultures to study tumor growth. **Mary Jane Guthrie** was also a cell biologist and mammalian zoologist who created *in vitro* ovaries to understand how tumors begin. **Salome Waelsch** earned a Ph.D. in Germany in 1932 and was another early mammalian geneticist who focused on genetic mutations of mice spines and tails; she

later researched the hereditary nature of blood cells and chromosomal defects that affect liver function. Also trained in Germany, **Berta Scharrer** studied invertebrate zoology and with her scientist husband pioneered a new field of neuroendocrinology. In the 1940s and 1950s, zoologist **Dorothy Pitelka** was one of the earliest cell researchers to use the electron microscope, and her research on simple organisms contributed to the understanding of cancer-causing viruses. In the late twentieth and early twenty-first centuries, there is not always a clear distinction between zoology and research that is now regularly conducted (using animal experiments, tissues, and cultures) in departments of microbiology, cell biology, genetics, and other biomedical specialties.

See also Animal Sciences; Biology; Biomedical Sciences; Environmental Sciences and Ecology; Genetics; Ocean Sciences; Primatology

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A

Aberle, Sophie Bledsoe

1896 1996

Nutritionist, Anthropologist

Education: A.B., Stanford University, 1923, M.S., 1925, Ph.D., genetics, 1927; M.D., Yale University, 1930

Professional Experience: assistant histologist, Stanford University, 1924–1925, assistant embryologist and neurologist, 1925–1926; instructor, anthropology, Institute of Human Relations, Yale University, 1927–1930, Sterling Fellow, School of Medicine, 1930–1931, instructor, 1930–1934; research associate, Carnegie Institute, 1934–1935; superintendent of Pueblo Indians, Bureau of Indian Affairs, and secretary, Southwest Superintendents Council, 1935–1944; division of medical science, National Research Council, 1944–1949; special research director, University of New Mexico, Albuquerque, 1949–1954; chief nutritionist, Bernalillo County Indian Hospital, 1953–1966; staff member, psychiatry, medical school, University of New Mexico, 1966–1970

Sophie Aberle enjoyed a remarkable career that included working as an anthropologist, a physician, a nutritionist, and a psychiatrist. Starting about 1935, when she held a position with the Bureau of Indian Affairs, Aberle became visible as an advocate for the Pueblo people in all areas of their lives, including health, education, culture, and living conditions. Her book, *The Pueblo Indians of New Mexico, Their Land, Economy and Civil Organization*, was published by the American Anthropological Association in 1948, and argued that retaining rights to their land was essential for Pueblo economic survival, as livestock farming was their primary source of financial, cultural, and tribal stability. She was married to William A. Brophy, who was a lawyer for the Pueblo Indians and served as U.S. Commissioner of Indian Affairs between 1945 and 1948. Together, Brophy and Aberle published a collection of reports on *The Indian: America's Unfinished Business* (1966; reprinted, 2001).

Aberle worked at both the local and national levels on such projects as the upper Rio Grande drainage basin committee; consultant for the health committee of the



Sophie Aberle, anthropologist, nutritionist, and physician. (Harry S. Truman Presidential Library)

All Indian Pueblo Council; member of New Mexico Nutrition Committee; member of the Committee of Maternal and Infant Mortality; member of White House Conference on Children in Democracy; chair of the board of directors for the Southwest Field Training School for Federal Service; member and later executive director of the Commission on Rights, Liberties, and Responsibilities of American Indians; director of a survey of Indian Education for the Bureau of Indian Affairs; consultant to the All Indian Pueblo Council on computer-assisted instruction programs; consultant for Stanford University's study of Indian education; and consultant for the bilingual/bicultural project of the Bernalillo School District. She served on the board of directors of numerous organizations such as Planned Parenthood, the county YWCA, and the Bernalillo County Indian Hospital.

Aberle was the first woman member of the National Science Board (the policy-making body for the National Science Foundation), serving on the board from 1950 to 1957. She was a member of the American Association for the Advancement of Science, American Anthropological Association, and the American Medical Association.

Abriola, Linda M.

b. 1954**Civil Engineer**

Education: B.S., civil engineering, Drexel University, 1976; M.S., civil engineering, Princeton University, 1979, M.A., 1980, Ph.D., civil engineering, 1983

Professional Experience: project engineer, Procter and Gamble Manufacturing Co., New York, 1976–1978; research and teaching assistant, Princeton University, 1979–1983, postdoctoral researcher, civil engineering, 1983; assistant to associate professor, civil and environmental engineering, University of Michigan, Ann Arbor, 1984–1996, director, Environmental and Water Resources Engineering Program, 1996–2001, professor, 1996–2003, Horace Williams King Collegiate Professorship, 2001–2003; dean and professor, civil and environmental engineering, and adjunct professor, chemical and biological engineering, Tufts University, 2003–

Concurrent Positions: visiting associate professor, petroleum engineering, University of Texas, Austin, 1991; visiting scientist, geotechnical engineering, Universitat Politecnica de Catalunya, Barcelona, Spain, 1992

Linda Abriola is a civil engineer whose research combines laboratory experiments and mathematical modeling of organic chemical liquid contaminants. She is one of the leaders of the Integrated Multiphase Environmental Systems (IMPES) laboratory at Tufts University, where she has been on the faculty and has been dean of engineering since 2003. She received her doctorate from Princeton in 1979 and, before her affiliation with Tufts, was professor and director of the Environmental and Water Resources Engineering Program at the University of Michigan, Ann Arbor.

Abriola was elected to the National Academy of Engineering in 2003. Her numerous awards include a National



Civil engineer, Linda Abriola. (Courtesy of Tufts University)

Science Foundation Presidential Young Investigator Award (1985), the Association for Women Geoscientist's Outstanding Educator Award (1996), the National Ground Water Association's Distinguished Darcy Lectureship (1996), and the SERDP Project of the Year Award in Environmental Restoration (2006). She is a fellow of the American Geophysical Union, and has been a member and invited participant of committees for the National Academy of Engineering, U.S. Environmental Protection Agency, and U.S. Department of Energy, and the National Research Council, including the NRC Committee on Gender Differences in Careers of Science, Engineering, and Mathematics Faculty.

Further Resources

Tufts University. Faculty website. <http://engineering.tufts.edu/cee/people/abriola/>.

Tufts University. Integrated Multiphase Environmental Systems Laboratory (IMPES). <http://engineering.tufts.edu/cee/impes/>.

Ackerman, Bernice

1924–1995

Meteorologist

Education: B.S., meteorology, University of Chicago, 1948, M.S., meteorology, 1955, Ph.D., geophysical science, 1965

Professional Experience: meteorologist and hydrologist, U.S. Weather Bureau, 1948–1953; research associate, Cloud Physics Laboratory, University of Chicago, 1953–1965, assistant professor, meteorology, 1965–1967; associate professor, meteorology, Texas A&M University, 1967–1970; associate meteorologist, Atmospheric Sciences Section, Argonne National Laboratory, 1970–1972; senior meteorologist, Illinois State Water Survey, University of Illinois, 1972–1978, principal scientist, 1978–1989, head of meteorology section, 1980–1989

Bernice Ackerman was a meteorologist at a time when the field was almost exclusively the domain of male scientists. During World War II, the U.S. government began to train women as meteorologists and hydrologists to make more men available for military service. Some of the female meteorologists, such as Ackerman, were members of the U.S. Navy's Women Accepted for Voluntary Emergency Services (WAVES), while others were civilian employees. Ackerman was the first woman weather forecaster in the United States, the only woman research meteorologist in the Cloud Physics Laboratory at the University of Chicago, and the first woman meteorologist at Argonne National Laboratory. After her wartime service

as a weather observer and flight briefer with WAVES, she attended the University of Chicago, where she received a bachelor's degree in meteorology with a minor in mathematics. She worked for the U.S. Weather Bureau for several years before returning to the University of Chicago to complete her master's degree. She stayed at Chicago as a research associate while completing her doctorate in geophysical sciences, which she received in 1965. She went on to teach boundary layer meteorology and cloud physics at Texas A&M University. She then joined the staff of Argonne National Laboratory, where she stayed two years before moving to the Illinois State Water Survey.

Ackerman was a fellow of the American Association for the Advancement of Science and a fellow of the American Meteorological Society. She was also a member of the American Geophysical Union.

Adams, (Amy) Elizabeth

1892 1962

Zoologist

Education: A.B., zoology, Mount Holyoke College, 1914; University of Chicago, 1916; A.M., Columbia University, 1919; Ph.D., zoology, Yale University, 1926; University of Edinburgh, 1930–1931

Professional Experience: laboratory assistant, zoology, Mount Holyoke College, 1914–1915, instructor to associate professor, 1915–1928, professor, 1928–1957

Concurrent Positions: honorary fellow, Yale University, 1922–1923

Elizabeth Adams was a zoologist who spent her entire career at Mount Holyoke College, where many female zoologists of the early twentieth century received their degrees. Her areas of research were experimental embryology and endocrinology, and she taught some of the first courses in heredity and in human embryology at Mount Holyoke as well as some of the first studies of the reproductive system. Her brother-in-law was a physician in Pennsylvania who helped collect fetal specimens for the college laboratories, including those used in Adams's courses. She was one of the most renowned women zoologists of her generation and obtained grants, even during the Depression Era of the 1930s, from sources such as the Bache Fund of the National Academy of Sciences, Sigma Xi, the American Association for the Advancement of Science, several committees of the National Research Council, and the Rockefeller Foundation. Particularly in women's colleges at that time, research funds, facilities, and faculty leave time were scarce or nonexistent.

Adams and her sister, Katherine Mary, both attended Mount Holyoke College as undergraduates. She went on to earn a master's degree from Columbia University and a doctorate in zoology from Yale University. She also took courses at the University of Chicago and University of Edinburg, but spent her entire teaching career at Mount Holyoke College. On several occasions, she served as acting head of the zoology department, and in 1926 served one semester as acting dean of the college. She retired in 1957. Adams was a member of several scientific societies, including the Endocrine Society and the Society for Experimental Biology and Medicine. She was also an elected fellow of the New York Academy of Sciences.

Further Resources

- Levin, Miriam R. 2005. *Defining Women's Scientific Enterprise: Mount Holyoke Faculty and the Rise of American Science*. Lebanon, NH: University Press of New England.
- Morgan, Lynn Marie. 2006. "The Rise and the Demise of a Collection of Human Fetuses at Mount Holyoke College." *Perspectives in Biology and Medicine*. 49(3): 435–451. (Summer 2006).

Adelman, Irma Glicman

b. 1930

Economist

Education: B.S., University of California, Berkeley, 1950, M.A., 1951, Ph.D., economics, 1955

Professional Experience: instructor, University of California, Berkeley, 1956–1957, assistant professor, 1957–1958; visiting assistant professor, Mills College, 1958–1959; assistant professor, Stanford University, 1959–1962; associate professor, Johns Hopkins University, 1962–1965; professor, economics, Northwestern University, 1966–1972; professor, economics, University of Maryland, 1972–1978; professor, economics and agricultural economics, University of California, Berkeley, 1979–1994, emeritus

Concurrent Positions: consultant, Division of Industrial Development, United Nations, 1962–1963; consultant, Agency for International Development, U.S. Department of Agriculture, 1963–1972; consultant, World Bank, 1968–

Irma Adelman is an internationally renowned economist whose research focuses on how the economic growth of nations is affected by and, in turn, affects economics and political institutions; how institutions and economic structure and choices affect the diffusion of benefits from economic and institutional change; and examining

income distribution and poverty, both descriptively and from a policy viewpoint. Adelman was born in Romania and emigrated to the United States with her family in 1949, her family escaping the fate of many Jews during that period. She attended Berkeley and, after completing her graduate work, was unable to find a permanent position. She held a series of short appointments at several schools, and when her physicist husband, Frank Adelman, accepted an appointment in the Washington, D.C., area, she obtained a position at Johns Hopkins University and began working on summer research projects at the Brookings Institution. She was invited to join the faculty at Northwestern University in 1966, and her husband followed her to the Chicago area. She went on to teach at the University of Maryland before returning to Berkeley as a professor. She has also served as a consultant to the United Nations Division of Industrial Development and the Bureau of Labor Statistics.

Adelman has received numerous appointments and awards for her work internationally, including awards in Korea and Vietnam. In 1977, she was invited to hold the Cleringa Chair at Leiden University in The Netherlands, a one-year appointment that rotates between a Dutch professor and a foreign professor. She was the fourth holder of the chair and the second economist. She has published more than 130 papers and books, was elected a fellow of the American Academy of Arts and Sciences, and is a member of the Econometric Society and the American Economic Association.

Agogino, Alice M.

b. 1952

Mechanical Engineer

Education B.S., mechanical engineering, University of New Mexico, 1975; M.S., mechanical engineering, University of California, Berkeley, 1978; Ph.D., engineering-economic systems, Stanford University, 1984

Professional Experience: project engineer, Dow Chemical, Texas, 1972–1973; mechanical engineer, General Electric, 1975–1978, commercial specialist, 1978–1979; systems analyst, SRI, 1980; director, Women-in-Engineering Program, University of Santa Clara, California, 1980–1981; principal, Agogino Engineering, 1979–; assistant professor to professor, mechanical engineering, University of California, Berkeley, 1984–

Concurrent Positions: associate dean, College of Engineering, University of California, Berkeley, 1995–1999; director, Instructional Technology Program, University of California, Berkeley, 1999–2001

Alice Agogino is a mechanical engineer whose research interests include intelligent learning systems, wireless sensor networks, design theory and methods, multimedia and computer-aided design (CAD), artificial intelligence, and gender equity. She has strong ties in both academia and industry and has played a prominent role in developing and reforming technology education, including bringing more women and minorities into science and engineering careers. She is director of the Berkeley Expert Systems Technology (BEST) Laboratory and the Berkeley Instructional Technology Studio (BITS), and director of Synthesis, a National Science Foundation (NSF)–sponsored project committed to undergraduate engineering education.

Dr. Agogino has authored numerous articles and publications and received prizes for best papers at engineering conferences. She has served on the editorial board of professional journals. Beyond her role in the university, she has been involved in collaborative projects with industry and has been a member or advisor for governmental and industry organizations and committees such as the National Science Foundation Advisory Committee for Engineering (1991–96, chair 1996–97), the National Research Council (NRC) Government-University-Industry Roundtable (1997–98), the NRC Committee on “Standards for Technology Education” (1997–98), the National Academy of Engineering (NAE) Academic Advisory Board (1998–2002), and the National Academies Board on Science Education (2005–2007), and is co-chair of the NAE Mechanical Engineering Nominating Committee (2007–2010). She also served on the National Academies Women in Academic Science Engineering Committee (2005–2006), the goal of which was to “report on maximizing the potential of women in academic science and engineering, including findings and recommendations for recruiting, hiring, promoting, and retaining women scientists and engineers.”

Agogino was inducted into the National Academy of Engineering in 1997, and is a fellow of the American Association for the Advancement of Science (engineering chair, 2001–2002), the European Academy of Science, the Association of Women in Science, and the American Society of Mechanical Engineers. She is also a member of the Institute of Electrical and Electronics Engineers and the Society of Women Engineers. Some of her earliest awards and honors include a NSF Presidential Young Investigator Award (1985) and the Young Manufacturing Engineer of the Year Award of the Society of Manufacturing Engineers (1987).

Further Resources

University of California. Faculty website. <http://www.me.berkeley.edu/faculty/aagogino.html>.

Ajzenberg–Selove, Fay

b. 1926

Nuclear Physicist

Education: B.S.E., University of Michigan, 1946; M.S., University of Wisconsin, 1949, Ph.D., physics, 1952

Professional Experience: assistant to associate professor, physics, Boston University, 1952–1957; associate professor to professor, Haverford College, 1957–1970; professor, physics, University of Pennsylvania, 1970–

Concurrent Positions: Smith-Mundt Fellow, U.S. State Department, 1955; visiting assistant professor, Columbia University, 1955; visiting professor, National University of Mexico, 1955; visiting associate physicist, Brookhaven National Laboratory, 1956; lecturer, University of Pennsylvania, 1957; Guggenheim Fellow, Lawrence Radiation Laboratory, 1965–1966; consultant, California Institute of Technology, 1970–1972

Fay Ajzenberg-Selove is an internationally recognized authority on nuclear structure. She was born in Berlin of Russian parents, but because of financial problems the family moved to Paris in 1930. The family was forced to flee that city in 1940 because some family members were Russian Jews who had supported the Communist Party. Fortunately, her family believed in education for women, and they allowed her to study any subjects she chose. She completed her high school education after arriving in the United States in 1941 and enrolled in the Engineering School at the University of Michigan, the only woman in a class of 100. After spending a year in the graduate school at Columbia University, she taught college-level mathematics at the University of Illinois, Chicago. She then entered the graduate school at the University of Wisconsin and received her degree in physics in 1952.

She was a joint editor of *Energy Levels of Light Nuclei* for the fourth edition (1952) and the fifth edition (1955); she has been solely responsible for the sixth edition (1973) and all subsequent editions. In addition to numerous other scientific publications, she has been active in encouraging women to pursue careers in physics. Her autobiography, *A Matter of Choices: Memoirs of a Female Physicist* (1994), describes many of the professional problems she faced, problems that still, unfortunately, plague women scientists today.

Ajzenberg-Selove is a fellow of the American Association for the Advancement of Science and of the American Physical Society, serving as chair of the Division of Nuclear Physics (1973–74). She was also a member of the Nuclear Science Advisory Committee of the Department of Energy (1977–80). Her numerous awards include the Christian and Mary Lindback Foundation Award for Distinguished

Teaching (1991), the Nicholson Medal for Humanitarian Service, American Physical Society (1999), the Distinguished Alumni Fellow Award, Department of Physics, University of Wisconsin (2001), and several honorary doctorates. In March 2006, the University of Pennsylvania held a special symposium in honor of the work of Fay Ajzenberg-Selove and her husband, Walter Selove, also a physicist.

Further Resources

University of Pennsylvania. Faculty website. <http://www.physics.upenn.edu/people/f.ajzenberg.html>.

Ajzenberg-Selove, Fay. 1994. *A Matter of Choices: Memoirs of a Female Physicist*. New Brunswick, NJ: Rutgers University Press.

Altmann, Jeanne

Primatologist, Anthropologist

Education: B.A., mathematics, University of Alberta, 1962; M.A.T., mathematics and teaching, Emory University, 1970; Ph.D., behavioral sciences/human development, University of Chicago, 1979

Professional Experience: statistical clerk, Laboratory of Human Development, Harvard University and Office of Mathematical Research, National Institutes of Health, 1959–1960; research associate and co-investigator in primate field studies, zoology, University of Alberta, 1963–1965; research associate and co-investigator, Yerkes National Primate Research Center, Emory University, Atlanta, Georgia, 1965–1967 and 1969–1970; research associate, biology, University of Chicago, 1970–1985, associate professor, ecology and evolution, 1985–1989, professor, 1989–1998; professor, ecology and evolutionary biology, Princeton University, 1998, faculty associate, Office of Population Research, 1999–, faculty associate, Princeton Environmental Institute, 2005–, Eugene Higgins Professor of Ecology and Evolutionary Biology, 2007–

Concurrent Positions: research curator and associate curator of primates, Chicago Zoological Society, 1985–; honorary lecturer, zoology, University of Nairobi, 1989–, visiting professor, animal physiology, 2003–2008

Jeanne Altmann is a primatologist and anthropologist who studies the demography, genetics, behavior, and life histories of wild primates. She has been involved in long-term full-time studies of baboon family units since founding the Amboseli Baboon Research Project in Kenya, Africa, in 1963 with her husband, primatologist Stuart Altmann. The Altmanns have organized the work of dozens of scientists and

researchers at Amboseli while serving as professors of primatology and evolutionary biology at the University of Chicago and, since 1998, at Princeton University. Jeanne Altmann became the primary director of the project; her work focuses on group social behavior and on the effects of genetics and environment on individual behavior, such as mate choice and parental care. Her 1980 book, *Baboon Mothers and Infants*, was one of the first studies of primate maternal roles and changed the course of primate research; a new edition was published in 2001.

Altmann was elected to the National Academy of Sciences in 2003. She is the recipient of an Animal Behavior Society Exemplar Award (1996), and a fellow of the American Association of Zoological Parks and Aquariums, Animal Behavior Society, and American Academy of Arts and Sciences.



Primatologist and anthropologist Jeanne Altmann. (Princeton University, Office of Communications, Brian Wilson)

Further Resources

Princeton University. "Altmann Laboratory." <http://www.princeton.edu/~altlab/>.

"Amboseli Baboon Research Project." <http://www.princeton.edu/~baboon/people.html>.

Altmann, Margaret

1900 1984

Animal Science, Biologist

Education: Ph.D., rural economics, University of Bonn, 1928; Ph.D., animal breeding, Cornell University, 1938

Professional Experience: farm manager, Germany, 1921–1930; dairy researcher, German government, 1928–1929; lecturer, German Agriculture Ministry, 1929–1931; Agricultural Council specialist, 1932–1933; assistant in animal breeding,

Cornell University, 1933–1938, research associate, psychobiology, 1938–1941; associate professor, biology and animal husbandry and department chair, Hampton Institute, 1941, professor, animal husbandry and genetics, 1941–1956; visiting lecturer, psychology, University of Colorado, 1958; visiting professor, psychology and biology, Kenyon College, 1959; professor, psychology, University of Colorado, 1959–1969; emerita, 1969–1984

Concurrent Positions: big game researcher, Biology Research Station, 1948–1956

Margaret Altmann was a researcher in psychobiology and animal husbandry and one of the first women who worked in the area of agricultural animal sciences, a field nearly the exclusive domain of male scientists at the time she was employed. Born in Berlin, she worked for several German government agricultural agencies and received a doctorate in rural economics from the University of Bonn in 1928. She then moved to the United States, where she earned a second doctorate in animal breeding from Cornell University in New York. She worked at Cornell as a psychobiologist before moving to the Hampton Institute (now Hampton University) in Virginia as professor of animal husbandry and genetics. She spent another 10 years as a professor of psychology, combining her interests in biology and psychology, at the University of Colorado, retiring in 1969. Earlier she was also a big game researcher at the Biology Research Station, where she studied and eventually published several papers on the maternal behavior of large mammals, such as moose and elk. Even today, this typically is considered a male profession, and it is a credit to Altmann's expertise and persistence that she succeeded in two male-dominated areas of research.

Altmann was a member of the American Association for the Advancement of Science, Genetics Society of America, and American Society of Mammalogists.

Further Resources

Chiszar, David and Michael Wertheimer. 2006. "Margaret Altmann: A Rugged Pioneer in Rugged Fields." *Journal of the History of the Behavioral Sciences*. 24(1): 102–106.

Ancker-Johnson, Betsy

b. 1929

Solid-state Physicist

Education: B.A., Wellesley College, 1949; Ph.D., physics, Tübingen University, 1953

Professional Experience: junior research physicist and lecturer in physics, University of California, Berkeley, 1953–1954; staff member, Inter-Varsity Christian

Fellowship, Chicago, 1954–1956; senior research physicist, Microwave Physics Laboratory, Sylvania Electric Products, Inc., 1956–1958; member of technical staff, David Sarnoff Research Center, Radio Corporation of America (RCA), 1958–1961; research specialist, Plasma Physics Laboratory, Boeing Scientific Research Laboratories, 1961–1970; supervisor, solid-state and plasma electronics, Boeing Aerospace Company, 1970–1971, manager, advanced energy systems, 1971–1973; assistant secretary for science and technology, U.S. Department of Commerce, 1973–1977; associate laboratory director, physics research, Argonne National Laboratory, 1977–1979; vice president, Environmental Activity Staff, GM Technical Center, General Motors Corporation, 1979–1992

Concurrent Positions: affiliate professor, electrical engineering, University of Washington, 1961–1973; visiting scientist, Bell Laboratories, 1967–1968; Regents Lecturer, Department of Electrical Engineering and Computer Science, University of California, Berkeley, 1988–1989

Betsy Ancker-Johnson is an internationally known solid-state physicist who had a distinguished career working for several corporations, reaching the level of a vice president at General Motors Corporation. In 1973, she was the first woman scientist to be appointed assistant secretary for science and technology at the U.S. Department of Commerce. She began her career as a lecturer at the University of California, Berkeley, where she met her future husband, Harold Johnson, a mathematics professor. When her husband accepted a position at Princeton University, she found a job at Boeing Corporation. After working several years in research, she requested that she be transferred to a management position.

While employed at Boeing, Ancker-Johnson received at least four electrical or related patents, of which she was the sole inventor of three. Other patents were for a solid density probe, a solid signal generator, and a solid-state amplifier and phase detector. She then spent four years at the Department of Commerce and, after leaving her position there, worked as associate laboratory director for physics research at Argonne National Laboratory. She then moved to General Motors as vice president in charge of environmental policy, the first woman vice president in the auto industry. In this capacity, she headed a staff of over 200 and was responsible for automobile safety, fuel economy, and noise and auto emissions, as well as for all waste from GM plants worldwide. In the 1980s, she became concerned about the automotive industry's role in global climate change, but the GM leadership did not yet heed her warnings. She retired from GM in 1992, but she went on to serve on the National Research Council to address the issue of global warming.

Ancker-Johnson was elected to membership in the National Academy of Engineering in 1975. She has been very active in promoting the role of women scientists, especially through her memberships in professional organizations. She served as

chair of the Energy Policy Committee (1981–84) and later Director of the Motor Vehicle Manufacturers Association (1982–92). Her concern about the environment led to her position as chair (1988–94) and later Director of the World Environment Center (1988–1994). She was also a councilor for the National Academy of Engineering beginning in 1995. She wrote the book *Nobel Prize Women in Science: Their Lives, Struggles, and Momentous Discoveries* (1993). She received honorary doctorates from New York Polytechnic Institute (1979), Bates College (1980), and the University of Southern California (1984), and is a fellow of the American Physical Society, the Institute of Electrical and Electronics Engineers (IEEE), and a member of the Society of Automotive Engineers. In some sources, her name is spelled as “Anker.”

Anderson, Gloria (Long)

b. 1938

Chemist

Education: B.S., Arkansas Agricultural, Mechanical and Normal College (now the University of Arkansas, Pine Bluff), 1958; M.S., Atlanta University, 1961; Ph.D., organic chemistry, University of Chicago, 1968

Professional Experience: instructor, chemistry, South Carolina State College, 1961–1962; instructor, chemistry, Morehouse College, 1962–1964; summer school professor, South Carolina State College, 1967; Calloway Associate Professor and chair, chemistry, Morris Brown College, 1968–1973, professor and chair, chemistry, 1973–1984, acting Vice President of Academic Affairs, 1984–1985, Dean of Academic Affairs, 1985–1989; Distinguished Scholar, United Negro College Fund UNCF, 1989–1990; professor, chemistry, Morris Brown College, 1990–, Interim President, 1992–1993, Dean of Science and Technology, 1996–

Concurrent Positions: vice chair, Corporation for Public Broadcasting (CPB), 1977–1979; research consultant, BioSPECS, Hague, Netherlands, 1990–; Certified Professional Chemist, American Institute of Chemists, 1992–

Gloria Anderson is an authority on the industrial, medical, and military applications of fluorine-19 chemistry. Fluorine-19 chemistry began to be an important field of research prior to World War II, when many commercial applications were discovered. Anderson chose fluorine-19 as her thesis topic and has retained it as her major interest in research. Her research has involved the use of nuclear magnetic resonance (NMR) spectroscopy, a procedure that enables an extremely sophisticated analysis of the molecular structures and interactions of various materials.

Anderson has conducted research in a variety of fields, and starting in 1971, the National Institutes of Health, the National Science Foundation, and the Office of Naval Research have funded her investigation of fluorine-19. She conducted research on amantadines, a drug used to prevent viral infection, under the sponsorship of the National Institutes of Health, and she held a faculty industrial research fellowship with the National Science Foundation in 1981 and with the Air Force Office of Scientific Research in 1984. In 1985, she conducted research on the synthesis of solid rocket propellants under the auspices of the Air Force Office of Scientific Research. She has been a research consultant for BioSPECS of the Hague, Netherlands, since 1990.

Anderson has been very much involved in education on the national level. She was appointed to the board for the Corporation for Public Broadcasting in 1972 for a six-year term, and while there, she chaired committees on minority training, minorities and women, and human resources development, and served as vice chair of the board from 1977 to 1979. She has also served on the review panel for the National Science Foundation's Women in Science Program. She is a member of the American Association for the Advancement of Science, the American Chemical Society, the National Institute of Science, the National Science Teachers Association, and the Georgia Academy of Science. In addition to teaching, she has held numerous academic and administrative positions, including department chair, dean, and interim president, at Morris Brown College in Atlanta, Georgia.

Anderson, Mary P.

b. 1948

Geologist, Hydrologist

Education: B.A., geology, State University of New York, Buffalo, 1970; M.S., geology, Stanford University, 1971; Ph.D., hydrology, Stanford University, 1973

Professional Experience: adjunct assistant professor, geology, Southampton College of Long Island University, 1973–1975; assistant to associate professor, geology and geophysics, University of Wisconsin, Madison, 1975–1985, professor, 1985–

Concurrent Positions: visiting lecturer, geology, State University of New York, Stony Brook, 1974

Mary P. Anderson is a professor of hydrogeology, which is the study of the Earth's groundwater and lake systems. Her research is focused in Wisconsin, where she is professor of geology and geophysics at the University of Wisconsin, Madison. She

has been involved in ongoing studies of how global climate change impacts groundwater and lake water levels as part of the National Science Foundation's Long Term Ecological Research (LTER) project in northern Wisconsin. This research also contributes to questions of environmental and ecological importance, such as restoration of wetlands and detection of groundwater contamination. She has published numerous articles and book chapters, and her books have been through multiple editions, including the textbooks *Introduction to Groundwater Modeling* (originally published 1982; co-authored with H. F. Wang) and *Applied Groundwater Modeling* (originally published 1992; co-authored with W. W. Woessner), which has been printed in Japanese and Chinese editions as well.

Anderson was elected to the National Academy of Engineering in 2006. She is a fellow of the American Geophysical Union and the Geological Society of America, which awarded her the O. E. Meinzer Award (1998) for her work in hydrogeology. She also received the Hubbert Award of the Association of Ground Water Scientists and Engineers and the National Ground Water Association (1992). She has been editor or editorial board member for numerous professional journals, most recently as editor-in-chief of *Ground Water* (2002–2007), the journal of the National Ground Water Association. Anderson has been sought out as a member of professional, regulatory, and government research committees such as the National Research Council Committee on Ground-Water in Relation to Coal Mining (1978–80), the Panel on Groundwater Contamination of the Geophysics Study Committee (1981–83), the Water Science and Technology Board (1984–87), an ad hoc Committee to advise the U.S. Army on groundwater modeling needs (1992), and the Committee on Hydrologic Science (1999–2003). She has been especially active with the American Geophysical Union, serving on its award selection and executive committees and as President of the Hydrology Section (1996–1998).

Further Resources

University of Wisconsin. Faculty website. <http://www.geology.wisc.edu/~andy/HOMEPAGE.htm>.

Angier, Natalie

b. 1958

Science Writer

Education: student, University of Michigan, 1974–1976; B.A., Barnard College, 1978

Professional Experience: technical writer, Texas Instruments, 1979; researcher to staff writer, *Discover* magazine, 1980–1983; editor, *Savvy* magazine, 1983–1984;

staff writer, *Time* magazine, 1984–1986; instructor, journalism, New York University, 1987–1989; reporter to science correspondent, *New York Times*, Washington, D.C., bureau, 1990–

Concurrent Positions: Andrew D. White Professor-at-Large, Cornell University, 2007–2012

Natalie Angier is a journalist who writes on scientific topics and has been acknowledged and praised for making the latest scientific research accessible to a wider audience. She has been a longtime science correspondent for the *New York Times* and a prolific contributor to essay anthologies, popular newspapers, and magazines. Her books include *Natural Obsessions: The Search for the Oncogene* (1988; reissued 1999), *The Beauty of the Beastly: New Views on the Nature of Life* (1995), *Woman: An Intimate Geography* (1999), and *The Canon: A Whirligig Tour of the Beautiful Basics of Science* (2007). She also co-edited the 2002 edition of *The Best American Science and Nature Writing*. In 1991, she received the prestigious Pulitzer Prize for reporting.

Angier's first book, *Natural Obsessions*, was based on time spent in a cancer research laboratory at the Massachusetts Institute of Technology (MIT). The book provided what one reviewer described as an important look at "the brutal intellectual Darwinism that dominates the high-stakes world of molecular genetics research." For the essay collection *The Beauty of the Beastly*, she examined various life forms in her characteristically technical but amusing writing style. Her book *Woman: An Intimate Geography* was a sweeping overview of scientific research on the female body, from the cellular to the anatomical and psychological. In *The Canon: A Whirligig Tour of the Beautiful Basics of Science*, Angier took an even wider view in an effort to get at the big issues in various scientific disciplines. She read the research and talked to active scientists from a variety of disciplines—biology, chemistry, physics, astronomy, evolutionary biology, environmental sciences, and others—bringing together the latest findings and presenting complex ideas to the lay reader. Angier has been praised in all of these works for advocating scientific literacy among the general public and for helping readers understand how science works in our daily lives.

Angier is a member of the National Association of Science Writers and, in addition to the Pulitzer Prize, she has been awarded the Lewis Thomas Prize from Rockefeller University (1990), an excellence in journalism award from the American Association for the Advancement of Science (1992), a Distinguished Alumnae Award from Barnard College (1993), and the Maggie Award of Planned Parenthood Federation (1999).

Further Resources

"Natalie Angier." <http://www.natalieangier.com>.

Anslow, Gladys Amelia

1892–1969

Physicist

Education: A.B., Smith College, 1914, A.M., 1917; Ph.D., physics, Yale University, 1924

Professional Experience: demonstrator, physics department, Smith College, 1914–1915, assistant, 1915–1917, instructor, 1917–1924, assistant professor to professor, 1924–1958

Concurrent Positions: chair, graduate school, Smith College, 1941–1958; chief, communications and information, Office of Scientific Research and Development (OSRD), 1944–1945

Gladys Anslow was physicist who studied spectroscopy of biological materials, ultraviolet vacuum spectroscopy, and nuclear structure problems. She was an outstanding teacher and researcher in the early twentieth century, when many women's colleges did not have adequate facilities for research in physics. At Smith College, Anslow took a course in spectroscopy with Janet T. Howell, with whom she researched the emission spectra of radium. After receiving her master's degree, Anslow completed some graduate coursework at the University of Chicago before entering the doctoral program at Yale. While working toward her Ph.D. in high-energy physics, she also taught courses at Smith and collaborated on research projects and joint publications in physics journals. After receiving her doctorate from Yale, Anslow spent her entire academic career at Smith College. She was invited to Berkeley in the summer of 1939 to work in the laboratory of E. O. Lawrence, who won the Nobel Prize in Physics that year. She returned to Smith to implement some of the methods she learned at Berkeley, but her projects were interrupted by the onset of World War II. Anslow was recruited by one of her Yale professors as a special assistant for the OSRD during the war. The OSRD was created to support research on wartime applications for scientific research, including radar, explosives, drug research, and the atomic bomb. Although many male scientists found employment with the OSRD during the war, Anslow was one of the few, and appears to have been one of the highest-ranking, women working in the organization. She became chief of communications, in liaison with civilian scientists working on military projects, and also retained her position at Smith throughout the war. She received a Presidential Certificate of Merit in 1948 from Harry Truman.

The postwar United States maintained a new level of commitment to and support for scientific research, and in the 1950s, Anslow was able to fund her work with government grants. While unable to secure enough funding for a new science

building at Smith as originally hoped, Anslow and her colleagues were able to upgrade facilities and buy new equipment, such as spectrophotometers, to support “physical and chemical studies of biologically important molecules” for medical applications. The women at Smith struggled with additional funding, however, when their findings did not corroborate those of leading male scientists, such as Linus Pauling. In the 1960s, however, their work was supported by the National Science Foundation, and Anslow was awarded an emeritus Sophia Smith Fellowship in 1966 to continue her research even after retirement.

Anslow was elected to Phi Beta Kappa and Sigma Xi, and she was a fellow of the American Physical Society and a member of the American Academy of Arts and Sciences, the American Association of Physics Teachers, the Optical Society of America, and the Society for Applied Spectroscopy.

Apgar, Virginia

1909–1974

Pediatrician

Education: B.S., zoology, Mount Holyoke, 1929; M.D., Columbia University, 1933; M.S., public health, Johns Hopkins School of Hygiene and Public Health, 1959

Professional Experience: resident and intern, surgery, Columbia Presbyterian Hospital, 1933–1937, director, anesthesia division, 1938–1959, professor, anesthesiology, 1949–1959; director, division of congenital malformations, National Foundation for Infantile Paralysis, 1959–1967, director, basic research, 1967–1968, vice president, medical affairs, 1971–1974

Concurrent Positions: honorary lecturer, medicine, Johns Hopkins School of Public Health, 1959, lecturer, genetics, 1973; lecturer, pediatrics, Cornell University, 1965–1971, clinical professor, pediatrics, 1971–1974

Virginia Apgar was a pioneer anesthesiologist, neonatologist, and pediatrician best known for developing the “Apgar score,” a scale for assessing the physical and mental health of newborn babies immediately after birth. Apgar had an early interest in science and medicine and graduated from Mount Holyoke College in 1929 with a major in zoology. She went on to receive her medical training from the Columbia University College of Physicians and Surgeons, receiving the M.D. in 1933. She completed a surgical residency at Columbia, but was discouraged from becoming a surgeon and sought training instead in the relatively new field of anesthesiology at both the University of Wisconsin, Madison and New York’s Bellevue Hospital in New York. She was only the second woman to be board-certified in anesthesiology

and returned to Columbia as director of the new anesthesia department in 1938. In 1949, she became the first female full professor at the College of Physicians and Surgeons. Apgar was interested in the effects on the baby of labor and delivery, including the effects of any anesthesia given to laboring women. She developed the “Apgar score,” assigning a 0- to 2-point rating to five measurements of newborn health assessed at 1 minute and 5 minutes after birth: heart rate, respiratory effort, muscle tone, reflex response, and color. The letters of her last name were later used to create an acronym for the five measurements: Appearance, Pulse, Grimace (reaction and irritability), Activity, and Respiration.

Apgar first published her method in 1953, and the score was accepted as a worldwide obstetrical standard for assessing newborn neurological health and survival rates. The test has been used by neonatologists for more than 50 years now and has been credited with contributing to a decline in infant mortality worldwide by changing birthing practices and alerting physicians to potential problems, allowing for early interventions. Apgar authored dozens of scientific papers and articles for magazines and newspapers, as well as co-authored the book *Is My Baby All Right?* (1972). She went on to earn a master’s degree in public health from Johns Hopkins University in 1959 and, after that time, left teaching to focus on public education and research funding, including an affiliation with the National Foundation for Infantile Paralysis (now the March of Dimes) as director of the division on birth defects and vice president of medical affairs.

Apgar was a fellow of the American Academy of Pediatrics and the American College of Obstetricians and Gynecologists, and a member of the American Society of Anesthesiologists (treasurer, 1941–1945). She received honorary doctorates from the Women’s Medical College of Pennsylvania (1964), from her alma mater, Mount Holyoke College (1965), and from the New Jersey College of Medicine and Dentistry (1967). Her other awards and honors include a Distinguished Service Award from the American Society of Anesthesiologists (1961), Elizabeth Blackwell Award of the American Women’s Medical Association (1966), Alumni Gold Medal for Distinguished Achievement from Columbia University College of Physicians and Surgeons (1973), and the Ralph M. Waters Award of the American Society of Anesthesiologists (1973). In 1973, she was also named Woman of the Year in Science by the *Ladies’ Home Journal*, and she has been honored posthumously with a U.S. postage stamp (1994) and with induction into the National Women’s Hall of Fame (1995). The American Academy of Pediatrics named its Virginia Apgar Award in Perinatal Pediatrics in her honor.

Further Resources

March of Dimes. “Virginia Apgar: Her Score Was a Win for Babies.” (28 May 2009). http://www.marchofdimes.com/789_59731.asp.

Archambault, JoAllyn

b. 1942

Anthropologist, Museum Program Director

Education: B.A., University of California, Berkeley, 1970, M.A., 1974, Ph.D., anthropology, 1984

Professional Experience: lecturer, Native American studies, University of California, Berkeley, 1976–1979; chair, Ethnic Studies Department, California College of Arts and Crafts, 1979–1980; part-time research associate, Center for the Study of Race, Crime and Social Policy, Cornell University, 1980–1982; assistant professor, anthropology, University of Wisconsin, Milwaukee, 1983–1986; director, American Indian Program, National Museum of Natural History, Smithsonian Institution, 1986–

JoAllyn Archambault is a prominent anthropologist and director of the American Indian program at the Smithsonian Institution in Washington, D.C. She was born into a mixed-blood Standing Rock Dakota, Creek, Irish, and French family in Claremore, Oklahoma. Her responsibilities at the museum consist of preserving and promoting Native American art, culture, and political anthropology. She functions as an ethnic liaison, supervises Native American fellowship interns, and manages a \$110,000 annual program budget. She was responsible for the redesign of the North American Indian Ethnology Halls for the “Changing Culture in a Changing World” exhibit. She has curated and implemented four major exhibits: “Plains Indian Arts: Change and Continuity” (1987), “100 Years of Plains Indian Painting” (1989), “Indian Basketry and Their Makers” (1990), and “Seminole!” (1990). She contributed to the Los Angeles Southwest Museum’s quincentennial exhibit “Grandfather, Hear Our Voices” in 1992.



Anthropologist JoAllyn Archambault, director of the American Indian program at the Smithsonian Institution in Washington, D.C. (Peter Turnley/Corbis)

Her research for her doctorate centered on the Gallup ceremonial, an annual tourist event held in Gallup, New Mexico, to display Native American arts of that region. Originally, the ceremonial was sponsored by white people as a business venture, but by the 1980s, the Native Americans had established their own dealer contacts. Since that time, her interests have included research in several urban and reservation communities, including reservation land use, health evaluation, expressive art, material culture, contemporary native culture, and the sun dance ceremony of eight different Plains groups. She has provided a great deal of assistance with respect to conservation, architecture, public programming, and research projects to tribes and to Native American-controlled museums, archives, and other types of cultural projects. She has lectured at several colleges both before and after joining the Smithsonian.

One of the controversies in Native American anthropology involves the number of skeletal remains that are housed in museums and laboratories across the United States. The problem continues to escalate because federal regulations require an anthropological analysis of any potentially historical material that is discovered. Although many people agree that the Native American skeletal remains should be returned to the tribes, it is often difficult to establish which tribe is involved or whether an established tribe still exists. Archambault has served on the Commission on Native American Reburial of the American Anthropological Association as well as on the University of California Joint Academic-Senate-Administration Committee on Human Skeletal Remains. She is a member of the American Ethnological Society as well as of several similar associations. Her work can be found in the permanent collections of several museums that specialize in Native American art. She published *An Annotated Bibliography of Sources on Plains Indian Art* (ca. 1995).

Attneave, Carolyn (Lewis)

1920 1992

Psychologist

Education: A.A., Yuba College, 1939; B.A., Chico State College (now California State University, Chico), 1940; M.A., Stanford University, 1947, Ph.D., psychology, 1952

Professional Experience: elementary school teacher, 1940–1942; director of student personnel, Texas Woman's University, 1956–1957; assistant professor, psychology and human development, Texas Technological College (now Texas

Tech University), 1957–1961; coordinator, Oklahoma State Department of Health, 1962–1969; senior psychologist, Philadelphia Child Guidance Clinic, 1969–1971; assistant professor, clinical psychology, Tufts University School of Medicine, 1971; coordinator of public service careers programs, Massachusetts Department of Mental Health, 1971–1972; supervisor of family therapy, Boston University, 1972–1975; research associate and lecturer, Harvard University School of Public Health, 1973–1975; professor, psychology and adjunct professor, behavioral sciences, University of Washington, Seattle, 1975–1987, director of American Indian studies, 1975–1977

Concurrent Positions: consulting psychologist and family therapist, private practice; U.S. Coast Guard Women’s Auxiliary (SPARS), 1942–1946

Carolyn Attneave was the founder of network therapy and probably the best-known Native American psychologist. She was internationally renowned for her expertise in cross-cultural topics in counseling and psychotherapy and for her pioneering work to extend family therapy to include the social network of the client. Her book *Family Networks: Retribalization and Healing* (1973) is considered the most comprehensive and significant presentation of social network therapy for families. Instead of merely assisting the client and family to solve an immediate problem, the therapist convenes a group as large as 40 people who are related to the identified client by blood, friendship, need, or physical proximity. The members of this large, diverse group bring their strengths to help the client cope with the problem and to prepare the client to handle the next crisis of living.

After receiving her Ph.D. in psychology from Stanford University in 1952, Attneave completed postdoctoral studies at the University of Chicago and the University of Oklahoma Medical School. Attneave’s theory of network therapy developed out of her work as an elementary school teacher working with troubled children within the larger context of family and community. However, her own experiences as a child visiting her grandparents during the summer on the Delaware Indian tribal lands in Oklahoma impressed on her the need to retain contact with her Indian heritage. Her mother was descended from the Delaware Indian tribes but had grown up with little knowledge of the customs and traditions of the community. While working for the Oklahoma State Department of Health, Attneave was able to develop the idea further. There, she collaborated with physicians, civic organizations, tribal and federal agencies, tribal leaders, and medicine men in providing mental-health services to the seven Native American tribes in the region.

Attneave became a founding member of the Boston Indian Council, one of the largest Native American centers in the country, and she started a newsletter,

Network of Indian Psychologists, to exchange information about services available to the American Indian community. The subscribers to the newsletter eventually evolved into a formal organization, the Society of Indian Psychologists. In 1981, she directed a project sponsored by the National Institute of Mental Health to compile a computerized bibliography of American Indian mental-health research. The bibliography is housed at the National Center for American Indian and Alaska Native Mental Health Research at the University of Colorado, Denver.

Austin, Pauline Morrow

b. 1916

Meteorologist

Education: B.A., Wilson College, 1938; M.A., Smith College, 1939; Ph.D., physics, Massachusetts Institute of Technology, 1942

Professional Experience: computer, Radiation Laboratory, Massachusetts Institute of Technology (MIT), 1941–1942, staff member, 1942–1945, research staff, 1946–1953; lecturer, Wellesley College, 1953–1955; senior research associate, MIT, 1956–1979

Pauline Austin was a meteorologist and at one time was the director of weather radar at Massachusetts Institute of Technology. Her areas of research were radar-scattering cross sections, propagation of electromagnetic waves in the atmosphere, storm tracking, and precipitation physics. She was a major participant in a profession that until World War II was almost exclusively a male domain. Austin was one of the first women identified as a meteorologist in the new era of radar technology. Her association with MIT started with the position of “computer” in the Radiation Laboratory in 1941, the year she was married to James Murdoch Austin, a meteorologist who specialized in air pollution and a pioneer weather broadcaster. At that time, several women, both civilians and military personnel, were trained under government auspices at the Radiation Laboratory to perform the work men formerly had handled. She studied both mathematics and physics as an undergraduate, earned a master’s degree at Smith, and received her doctorate in physics from MIT in 1942, in a program that included only four female students. She continued as a member of the MIT Radiation Laboratory research staff until 1979, except from 1953 to 1955, when she was a lecturer at Wellesley College. She became director of MIT’s Weather Radar Project. Even after her formal retirement, she has remained involved in scientific research, and volunteers with the Florida Museum of Natural History.

Austin received several honors, including an honorary doctorate from Wilson College in 1964 and election as a fellow of the American Meteorological Society. She served as associate editor of the *Journal of Applied Meteorology*.

Further Resources

Wilson College. Profile. <http://www.wilson.edu/wilson/asp/content.asp?id=3431>.

Avery, Mary Ellen

b. 1927

Pediatrician

Education: B.A., Wheaton College, 1948; M.D., Johns Hopkins University, 1952

Professional Experience: pediatrics staff, Johns Hopkins Hospital, 1952–1957; research fellow, pediatrics, Harvard University Medical School, 1957–1959; fellow in medicine, Johns Hopkins University, 1959–1960, assistant to associate professor, pediatrics, 1961–1969, pediatrician, Johns Hopkins Hospital, 1962–1969; professor, pediatrics, McGill University Children’s Hospital, 1969–1974; Thomas Morgan Rotch Professor of Pediatrics, Harvard University Medical School, and physician-in-chief, Children’s Hospital, Boston, 1974–1985, physician-in-chief emeritus, 1985–

Mary Ellen Avery is a neonatologist who discovered the medical condition called infant *respiratory distress syndrome* (RDS) and participated in developing treatments for the condition. She became interested in diseases of the lungs when she developed tuberculosis soon after completing medical school in 1952. The standard treatment at the time was simply bed rest, and medications to treat the disease were just being developed. In her research on infants, she found that RDS resulted from the lack of a fluid called *pulmonary surfactant*, which normally coats the internal surface of the lungs. Prior to her studies, it was thought that the hyaline membranes were the cause of the infant deaths. She also pioneered the discipline of the metabolism of the lung as her work on the surfactant led to the study of the nature of lung tissue. In addition to numerous journal publications, Avery has written several books: *The Lung and Its Disorders in the Newborn Infant* (first published in 1964 and considered a classic in the field; 4th ed., 1981), *Diseases of the Newborn* (6th ed., 1991), *Born Early* (1984), and *Pediatric Medicine* (2nd ed., 1994).

Avery was elected to membership in the National Academy of Sciences in 1994. In addition to honorary degrees, she has received numerous awards, including the Trudeau Medal from the American Lung Association (1984), the National

Medal of Science (1991), the Virginia Apgar Award from the American Academy of Pediatrics (1991), a Medical Alumnus Award from Johns Hopkins Medical School (1997), the Alfred I. duPont Award for Excellence in Children's Health Care (2005), and the John Howland Medal of the American Pediatric Society (2005). She is a fellow of the American Association for the Advancement of Science (president, 2003), and a member of the American Academy of Arts and Sciences, the American Academy of Pediatrics, the American Physiological Society, the Society of Pediatric Research (president, 1972–1973), and the American Pediatric Society (president, 1990).

Further Resources

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

“Dr. Mary Ellen Avery.” Changing the Face of Medicine: Celebrating America's Women Physicians. National Library of Medicine. National Institutes of Health. http://www.nlm.nih.gov/changingthefaceofmedicine/physicians/biography_17.html.

Avery, Susan K.

b. 1950

Oceanographer, Atmospheric Scientist

Education: B.S., physics, Michigan State University, 1972; M.S., physics, University of Illinois, 1974, Ph.D., atmospheric science, 1978

Professional Experience: research associate, Aeronomy Laboratory, University of Illinois, Urbana, 1978, assistant professor, electrical engineering, Aeronomy Laboratory, 1978–1982; associate professor, electrical and computer engineering, University of Colorado, Boulder, 1985–1992, professor, 1992–2008; director and president, Woods Hole Oceanographic Institution (WHOI), Massachusetts, 2008–

Concurrent Positions: visiting fellow, Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder, 1982–1983, fellow, 1983–, director, CIRES, 1994–2004; director, Center for Limb Atmospheric Sounding (CLAS), University of Colorado, Boulder, 1996–2004

Susan Avery is an oceanographer and atmospheric researcher who became the first female director of the Woods Hole Oceanographic Institution in 2008. As the head of Woods Hole (one of the oldest and most prestigious oceanographic research centers in the United States), Avery presents ocean and earth sciences research and

perspectives to the U.S. government and to international organizations and conferences that inform policy and educational agendas. Before joining Woods Hole, Avery was a professor of atmospheric engineering at the University of Colorado and, previously, the University of Illinois. Her own research has focused on the development of radar techniques and remote sensing for studying precipitation, climate, and other geophysical and atmospheric data. Avery also held a number of high-level administrative posts at Colorado, including associate dean of the College of Engineering and Interim Vice Chancellor. She served for 10 years as director of the Cooperative Institute for Research in Environmental Sciences, a research and policy organization for which she also coordinated K–12 education efforts.

Avery earned a bachelor's degree in physics from Michigan State University and a master's degree in physics and a doctorate in atmospheric science from the University of Illinois in 1978. She has consulted for or served on the boards or advisory panels of numerous educational, policy, and government organizations, including the National Oceanic and Atmospheric Administration (NOAA), the national Climate Change Science Program, the Jet Propulsion Laboratory, the University Corporation for Atmospheric Research, the National Science Foundation, and the National Research Council.

Avery was acknowledged for her service, teaching, and scholarship by several awards of the University of Colorado, including the Margaret Willard Award of the University Women's Club (1995), Elizabeth Gee Memorial Lectureship Award (1998), and Robert L. Stearns Award (1999). She was also honored with a National Science Foundation Faculty Award for Women (1991) and an Outstanding Publication Award of the National Center for Atmospheric Research (1990), and was a Charter Member of the National Associates Program of the National Academies of Science (2001). She is also a fellow of the Institute of Electrical and Electronics Engineers, American Meteorological Society (president, 2004), American Association for the Advancement of Science, and a member of the American Geophysical Union.

Further Resources

"Biography: Susan K. Avery, PhD." <http://www.whoi.edu/page.do?pid=19538>.

B

Baber, Mary Arizona “Zonia”

1862 1956
Geographer

Education: B.S., University of Chicago, 1904

Professional Experience: principal, private school, 1886–1888; teacher, Cook County Normal School, 1888–1890, head, department of geography, 1890–1899; associate professor and head, geography and geology department, School of Education, University of Chicago, 1901–1921, principal, Elementary School, School of Education, University of Chicago, 1901–1921

Zonia Baber was one of the earliest women geographers and was recognized as a pioneer in developing a rational basis for teaching geography. Her career paralleled the pattern of many women of her age, that of teaching school for a number of years before obtaining an undergraduate degree; in fact, she was already teaching geography and geology at the University of Chicago at the time she received her degree in 1904, another practice common at that time. She was noted for the quality of the curriculum of her geology department at the university. She was a member of several professional societies and was one of the founding members of the Chicago Geographic Society. At the fiftieth anniversary meeting of the society in 1848, Baber was presented with a Gold Medal in recognition of her role in its founding and her service as President of the Society.

Baber authored *Stony Island: A Plea for its Conservation* (1917), a publication of the Geographic Society of Chicago. Later, she was involved in the peace movement and published a pamphlet of the Women’s International League of Peace and Freedom (WILPF) entitled *Peace Symbols* (1948). A member of the National Society for the Scientific Study of Education, she wrote several journal articles on the topic of teaching geography. Some sources erroneously identify her name as “Barber.”

Further Resources

Monk, Janice. 2004. “Women, Gender, and the Histories of American Geography.” *Annals of the Association of American Geographers*. 94(1): 1–22. (March 2004).

Baca Zinn, Maxine

b. 1942

Sociologist

Education: B.A., California State College, Long Beach (now California State University, Long Beach), 1966; M.A., University of New Mexico, 1970; Ph.D., sociology, University of Oregon, 1978

Professional Experience: instructor, New Careers Program, University of New Mexico, 1969–1971; instructor, sociology, University of New Mexico, 1970–1971; instructor, sociology and Chicano Studies, University of Michigan, Flint, 1975–1978, assistant professor to professor, sociology, 1978–1990; professor and Senior Research Associate, Julian Samora Research Institute, Michigan State University, 1990–

Concurrent Positions: program faculty, Master of Liberal Studies in American Culture, University of Michigan, Flint, 1978–1990; faculty associate, Survey Research Center, University of Michigan, 1979–1981; visiting scholar, Center for Research on Women, Memphis State University, 1984; visiting professor, sociology, University of California, Berkeley, 1986; Research Professor in Residence, Center for Research on Women, Memphis State University, 1987; Distinguished Visiting Professor, Women’s Studies, University of Delaware, 1988–1989; guest professor, sociology, University of Connecticut, 1988; visiting scholar, Henry A. Murray Research Center, Radcliffe College, 1997

Maxine Baca Zinn was one of the first people to conduct sociological work on Latino families and Mexican American women. She is a pioneer in the field of family, race, and ethnic relations, and some of her colleagues refer to her as one of the mothers of Chicana feminism. As an undergraduate sociology student, she could not identify with what her professors were saying when they were discussing minorities, for the discussions in no way reflected the Chicana life she knew.

Baca Zinn argues that Mexican American women have been especially maligned because of erroneous assumptions and limited empirical research. In an 1982 essay in the journal *Signs*, she explained that Chicanas “have been portrayed as long-suffering mothers who are subject to the brutality of insecure husbands and whose only function is to produce children—as women who themselves are childlike, simple, and completely dependent on fathers, brothers, and husbands. Machismo and its counterpart of female submissiveness are assumed to be rooted in a native cultural heritage.” Her research has focused on examining the more complex roles of the Chicana in society, highlighting the similarities between all minority women—Chicana, black, Asian, and so forth—and

arguing that minority women's subordination lies, in part, in their exclusion from American public life. In her book, *Women of Color in U.S. Society* (1995), she and other scholars explore race, class, and gender as systems of oppression against women of color in the United States. She has published numerous articles and books chapters on Chicana women and minority family structure.

Baca Zinn has received several awards for her research, including Outstanding Alumnus Awards from both California State University, Long Beach (1990) and the University of New Mexico (1993), the Cheryl Miller Lecturer Award on Women and Social Change (1989), the Meyers Center Book Award for the Study of Human Rights in North America (1997), and two separate prestigious awards from the American Sociological Association in 2000. She has also received a special recognition award for contributions to the Western Social Science Association, of which she was president in 1985–1986.

Further Resources

Michigan State University. Faculty website. <http://www.jsri.msu.edu/bacazinn/>.

Baetjer, Anna Medora

1899–1984

Physiologist, Toxicologist

Education: A.B., Wellesley College, 1920; Sc.D., physiology, physiological hygiene, and industrial health, Johns Hopkins University, 1924

Professional Experience: assistant, School of Hygiene and Public Health, Johns Hopkins University, 1923–1924, instructor, 1924–1927, associate, 1927–1945, assistant to associate professor, environmental medicine, 1945–1961, professor, 1962–1970

Anna Baetjer was a physiologist and toxicologist who studied the relationship between chromium and cancer as a pioneer in the field of occupational health. Among her many publications was the wartime report on *Women in Industry: Their Health and Efficiency* (1946), which made recommendations on workplace accommodations for women workers. She spent most of her career in the School of Hygiene and Public Health at Johns Hopkins University, where, in 1963, she helped establish one of the first environmental toxicology programs and helped set global standards for worker health. She was a frequent advisor and consultant to associations and government committees concerning occupational health and toxicology, such as the National Research Council, the Environmental Protection

Agency, and the U.S. Army Environment Hygiene Agency. Her earliest studies in the 1920s examined the effects of temperature and humidity on workers. By the 1950s and 1960s, she was warning about the effects of air pollution and calling for further studies on workplace chemical exposure. Even after her retirement in 1970, she remained active as a researcher and public health advocate, and her findings had an impact on studies related to environmental toxins, cancer, and lead poisoning, among other issues.

Baetjer was a member of numerous commissions and committees, including a consultant for the preventive medicine division of the Office of Surgeon General of the Army (beginning in 1947), a member of the board of trustees of the Mellon Institute (beginning in 1958), and a member of the advisory committee on safety of pesticide residues in foods to the Food and Drug Administration (1966–1970). She was elected president of the American Industrial Hygiene Association (1951), and she received the Cummings Memorial Award (1964), the Kehoe Award of the American Academy of Occupational Medicine (1976), the Stokinger Award of the American Conference of Government Industrial Hygienists (1980), and the Alice Hamilton Award (1997). She received honorary degrees from Woman's Medical College of Pennsylvania (1953), Wheaton College (1966), and Johns Hopkins University (1979). Johns Hopkins also established a chair in her name, the Anna M. Baetjer Chair in Environmental Health Sciences. Baetjer was a member of the American Physiological Society and the American Public Health Association.

Further Resources

"Occupational Health's Dynamo." *Prologues*. Johns Hopkins Public Health Magazine. (Fall 2001). <http://www.jhsph.edu/magazineFall01/Prologues.htm>.

Bahcall, Neta

b. 1942

Astrophysicist

Education: B.S., physics and mathematics, Hebrew University, Israel, 1963; M.S., physics, Weizmann Institute of Science, Israel, 1965; Ph.D., astrophysics, Tel Aviv University, Israel, 1970

Professional Experience: research fellow, physics, California Institute of Technology, 1970–1971; research associate to senior research astronomer, astrophysical sciences, Princeton University, 1971–1983; chief, General Observer Support Branch, and head, Science Program Selection Office, Space Telescope Science Institute,

1983–1989; professor, astrophysical sciences, Princeton University, 1989–; director, Council on Science and Technology of Princeton University, 2000–2008

Neta Bahcall is an astrophysicist and cosmologist whose research focuses on dark matter, the formation and evolution of galaxies, quasars, and the large-scale structure of the universe. She has mapped the structure and location of galaxies within the universe using the Hubble Space Telescope and other survey tools. Her most significant contribution to the field of astrophysics is her calculations of the total mass of the universe, which helps scientists understand both the origins and fate of the universe. She received her Ph.D. in astrophysics at Tel Aviv University in Israel and that same year became



Astrophysicist Neta Bahcall. (Princeton University, Office of Communications, Denise Applewhite)

affiliated with Princeton University. She has spent her entire teaching career at Princeton University and has been a full professor since 1989. During the 1980s, she spent time at the Space Telescope Science Institute and was in charge of selecting science programs that would use the Hubble Space Telescope. She collaborated for many years with her late husband, John Bahcall, also a renowned astrophysicist who worked on the development of the Hubble Space Telescope. She has authored or co-authored (with John Bahcall and others) hundreds of scientific papers and articles.

Neta Bahcall was elected a member of the National Academy of Sciences in 1997. She has been an invited lecturer for professional organizations and universities across the United States and internationally, including as lecturer at the Nobel Symposium in Stockholm (1998). She is a member of the American Astronomical Society (vice president, 1995–1998) and has served on numerous professional and governmental committees including the National Astronomy and Astrophysics Advisory Committee (2003–present), Space Telescope Institute Council (1993–1997), U.S. National Committee to IAU (1998–2004), Scientific Advisory Committee, Sloan Digital Sky Survey (1990–1995), and the American Institute of Physics Committee on International Relations (1990–1993), and as

chair of the AAS Committee on the Status of Women in Astronomy (1983). She has received an honorary doctorate from Ohio State University (2006). She has three children, all of whom have earned doctorates in the sciences.

Further Resources

Princeton University. Faculty website. <http://www.astro.princeton.edu/people/bahcallneta.html>.

Schultz, Steven. "Astrophysicist Reaches for the Stars and More." *Princeton Weekly Bulletin* 92(15). (10 February 2003). <http://www.princeton.edu/pr/pwb/03/0210/1b.shtml>.

Bailey, Florence Augusta Merriam

1863 1948

Ornithologist

Education: A.B., Smith College, 1921

Professional Experience: independent author

Florence Bailey was a popularizer of natural history who specialized in ornithology. Her first book was *Birds through an Opera Glass* (1889), which was comprised of revised versions of articles she had contributed as a student to *Audubon Magazine*. In 1894, she published *My Summer in a Mormon Village*, in 1896, *A-Birding on a Bronco*, and in 1898, *Birds of Village and Field*. The latter is a book for beginners in ornithology and one of the first popular American bird guides. Her brother, Clinton Hart Merriam, was the first chief of the U.S. Biological Survey, and her husband, Vernon Bailey, was its chief naturalist. She joined her husband on the majority of his field research trips, observing the birds about which she wrote. She also wrote chapters on birds in some of her husband's books, notably *Wild Animals of Glacier National Park* (1918) and *Cave Life of Kentucky* (1933). Her *Handbook of Birds of the Western United States* (1902) was a standard work for many years. She wrote the first comprehensive report on the bird life of the Southwest in *Birds of New Mexico* (1928), published by the New Mexico Department of Game and Fish.

Bailey was the first woman member of the American Ornithologists' Union in 1885 and, in 1929, was elected the first woman fellow. In 1931, she was the first woman to receive the Brewster Award of the American Ornithologists' Union. In 1933, the University of New Mexico awarded her an honorary LL.D. degree. In some sources, she is listed as "Mrs. Vernon Bailey."

Further Resources

- Bonta, Marcia M. 1995. *American Women Afield: Writings by Pioneering Women Naturalists*. College Station: Texas A&M University Press.
- Kofalk, Harriet. 1989. *No Woman Tenderfoot: Florence Merriam Bailey, Pioneer Naturalist*. College Station: Texas A & M University Press.
- Holmes, Madelyn. 2004. *American Women Conservationists: Twelve Profiles*. Jefferson, NC: McFarland.

Banfield, Jillian F.

b. 1959

Geochemist

Education: B.Sc., Australian National University, Canberra City, 1981, M.Sc., 1985; Ph.D., Johns Hopkins University, 1990

Professional Experience: exploration geologist, Western Mining Corporation, 1982–1983; research assistant, electron microscopy, Australian National University, 1985–1986; assistant to associate professor, geology and geophysics and Materials Science Program, University of Wisconsin, Madison, 1990–1999, professor, 1999–2001; professor, earth and planetary science and environmental science, policy, and management, University of California, Berkeley, 2001–

Concurrent Positions: associate professor, Mineralogical Institute, University of Tokyo, 1996–1997, professor, 1998; visiting research fellow, Australian National University, 1998–2000; affiliate faculty, chemistry, University of Wisconsin, Madison, 1998–2001; researcher, Lawrence Berkeley National Laboratory, 2001–

Jillian Banfield is an earth scientist who specializes in mineralogy and geochemistry. Her research focuses on the effect of microorganisms and biochemical processes on minerals, metals, and crystal growth. Banfield was born in Australia and received her bachelor's and master's degrees from Australian National University. She moved to the United States to conduct doctoral research at Johns Hopkins University in Baltimore, Maryland. She received her Ph.D. in 1990 and joined the faculty at the University of Wisconsin, Madison, where she taught for 11 years. During that time, she took a leave of absence to teach for two years at the Mineralogical Institute at the University of Tokyo. In 2002, she moved to the University of California, Berkeley as professor of earth, planetary, and environmental sciences. She is also affiliated with the geochemistry group at Lawrence Berkeley National Laboratory. She has served on advisory committees for the National Academy of Science Board on Earth Sciences and Resources and the U.S. Department of

Energy Geoscience Advisory Committee, and has been involved in an astrobiology research with the National Aeronautics and Space Administration (NASA) analyzing potential evidence of biological materials in planetary geological samples.

Banfield was the recipient of a prestigious five-year MacArthur Foundation “genius” grant (1999–2004) and, during this same time period, a Guggenheim fellowship (2000). Her other awards and honors include the Mineralogical Society of America Award (1997), D. A. Brown Medal from her alma mater, Australian National University (1999), and Marion L. and Christie M. Jackson Award of the Clay Minerals Society (2000). She has also been honored as the Gast Lecturer of the Geochemical Society (2000), the Inaugural National Science Foundation Earth Science Week Lecturer (2000), and the Rosenqvist Lecturer in Norway (2005), and was the Pioneer Lecturer for the Clay Minerals Society (2005). She is a member of the Mineralogical Society of America, Clay Minerals Society, American Geophysical Union, and American Society for Microbiology.

Further Resources

University of California, Berkeley. Faculty website. <http://eps.berkeley.edu/~jill/>.

Baranescu, Rodica

b. 1940

Mechanical Engineer

Education: B.S., mechanical engineering, Institute Francais du Petrol, Rueil-Malmaison; M.S., mechanical engineering, Politehnica University, Bucharest, Romania, 1961, Ph.D., mechanical engineering, 1970

Professional Experience: assistant to associate professor, Politehnica University, Bucharest, Romania, 1964–1978; chief engineer, Engine Performance Analysis, Technical Center of Engine and Foundry Division, International Truck and Engine Corporation, and manager, Fuels and Lubricants and Engine Group, International Truck and Engine Corporation, 1980–; professor, Mechanical and Industrial Engineering, University of Illinois, Chicago, 2005–

Rodica Baranescu is a mechanical engineer who has worked in the automotive industry on the development of diesel truck engines, and researching alternative fuels, energy, and emissions control. She received her education in France and at the Politehnica University in Bucharest, Romania, where she also taught for 14 years. She came to the United States in 1980 to work for International Harvester Company, now International Truck and Engine Corporation. She has served as chief engineer for Engine Performance Analysis and manager of the Fuels and

Lubricants division. She is co-author of two Romanian patents: Internal Combustion Engine with Damping Chamber and Accumulator Fuel Injection System for Diesel Engine. In 2005, she began an affiliation with the University of Illinois, Chicago as professor of mechanical and industrial engineering and has been an invited speaker and lecturer for industry and academic groups worldwide. She was co-editor of the 1999 edition of the *Diesel Engine Reference Book*.

Baranescu was elected to the National Academy of Engineering in 2001. She is a fellow of the Society of Automotive Engineers International (SAE) and was SAE president in 2000, the first woman to lead that group. Through the SAE, she committed herself to promoting engineering education and careers among young people and to increasing the presence of women and minorities in the field of automotive engineering; at that time, less than 5% of SAE members were women. She is the recipient of the American Society of Mechanical Engineering (ASME) Internal Combustion Engine Award (2003).

Further Resources

Hatch, Sybil E. 2006. *Changing Our World: True Stories of Women Engineers*. Reston, VA: American Society of Civil Engineers.

University of Illinois. Faculty website. <http://www.mie.uic.edu/faculty/baranescu.htm>.

Bartoshuk, Linda

b. 1938

Psychologist

Education: B.A., psychology, Carleton College, Minnesota, 1960; M.Sc., psychology, Brown University, 1963, Ph.D., psychology, 1965

Professional Experience: research associate, Brown University, 1964–1966, lecturer, 1966–1968; affiliate assistant professor, Clark University, 1966–1969; research psychologist, Natick Army Laboratories, 1966–1970; assistant fellow, John B. Pierce Foundation, 1970–1973, associate, 1974–1985, fellow, 1985–1989; assistant professor, epidemiology and public health, Yale University, 1971–1976, associate professor, epidemiology and public health, and psychology, 1976–1985, professor, 1985–1988, professor, surgery (otolaryngology) and psychology, Yale University, 1989–2005; professor, Community Dentistry and Behavioral Science, University of Florida, College of Dentistry, 2005–

Linda Bartoshuk is a research psychologist who conducts innovative research on perceptions of taste and smell. She has researched how genetic differences in taste,

and damage to taste buds, affect our sense of pain and our overall health. She spent many years as otolaryngology researcher and professor of epidemiology, public health, and psychology at Yale University before moving to the McKnight Brain Institute's Center for Taste and Smell at the University of Florida College of Dentistry. In particular, she has looked at how the taste buds send signals to the brain, and the effects of hormones and of cancer therapy and disease on taste. Her work has clinical and pharmaceutical applications for treating patients with oral pain and taste bud damage, as well as applications to the food industries in linking taste preferences to health and dietary needs.

Bartoshuk received her doctorate in psychology from Brown University in 1965. She worked at the Natick Army Research Labs before joining the Pierce Foundation and then the faculty at Yale University in 1971. She has been an editor or consulting editor for journals such as *Chemical Senses*, *Perception and Psychophysics*, and *Sensory Processes*. She has served on numerous advisory boards and committees for the National Institutes of Health and the National Research Council, and was on the Women's Affairs Advisory Committee of the American Association of Dental Schools.

Bartoshuk was elected to the National Academy of Sciences (NAS) in 2003 and in 2008 was appointed to a three-year term on the Council of the NAS. She is a fellow of the Society for Experimental Psychologists, the American Academy of Arts and Sciences, and the Connecticut Academy of Science and Engineering, and a founding member of the Association for Psychological Science (president, 2008). She is also a member of the American Psychological Association, American Psychological Society, Association for Chemoreception Sciences (AChemS) (president, 1980–1981), Eastern Psychological Association (president, 1990–1991), Psychonomic Society, and Society for the Study of Ingestive Behavior. She received an honorary doctorate from Carleton College (2001). Among her numerous other awards and honors are the Manheimer Award of Monell Chemical Senses Institute (1990), the Leah Lowenstein Award of Yale University School of Medicine (1991), AChemS Award for Outstanding Achievement in the Chemical Senses (1998), a Distinguished Contribution Award of the New England Psychological Association (2000), and the International Flavors and Fragrances Award for Innovative Research (2004).

Further Resources

O'Connell, Agnes N. and Nancy Felipe Russo, eds. 2001. *Models of Achievement: Reflections of Eminent Women in Psychology*. Vol. 3. Mahwah, NJ: Lawrence Erlbaum Associates.

"Cool Careers in Science." PBS interview. http://www.pbs.org/safarchive/5_cool/53c_bartoshuk.html.

Bascom, Florence

1862 1945

Geologist

Education: A.B., B.L., University of Wisconsin, 1882, B.S., 1884, M.A., geology, 1887; Ph.D., geology, Johns Hopkins University, 1893

Professional Experience: instructor, geology and petrology, Ohio State University, 1893–1895; lecturer and associate professor, geology, Bryn Mawr College, 1895–1906, professor, 1906–1928; geological assistant, U.S. Geological Survey (USGS), 1896–1901, assistant geologist, 1901–1909, geologist, 1909–1936

Florence Bascom introduced the microscopic study of minerals in the United States and is considered the first female professional geologist. She was a petrologist who studied rock formations and published numerous articles on the crystalline rocks of the Piedmont area from the Susquehanna River to Trenton, New Jersey. She was the first woman to receive a doctorate from Johns Hopkins University and the first American woman to receive a doctorate in geology. After teaching for two years at Ohio State University, she moved to Bryn Mawr College. At that time, Bryn Mawr had no facilities for geological research, but Bascom secured rock and mineral specimens and expanded her geology course into a full major. She soon was accepting graduate students from all over the country and from Europe, training an entire generation of American women geologists. One of her students was **Eleanora Bliss Knopf**, who also went on to work for the USGS. In 1896, Bascom became the first woman scientist hired at the USGS. She retired from teaching at Bryn Mawr in 1928 due to poor health, but continued conducting fieldwork and laboratory research for USGS for several more years.

Bascom came from an academic background, as her father, John Bascom, was a professor at Williams College in Massachusetts and later president of the University of Wisconsin, where Florence enrolled as an undergraduate, receiving three separate bachelor's degrees as well as a master's degree in geology. She then enrolled in Johns Hopkins University in Baltimore, Maryland. Johns Hopkins did not yet officially admit women or grant women degrees, but allowed them to take graduate courses. Bascom sat behind a screen during classes, separate from the male students, and received her doctorate from Johns Hopkins in 1893 by special dispensation.

Bascom accomplished several other “firsts” in her field, including as the first woman to present a scientific paper at the Geological Society of Washington, the first woman to be elected a fellow of the Geological Society of America (1894), and the first female officer of that organizations (vice president, 1930). She also served as editor of *The American Geologist*.

Further Resources

Arnold, Lois Barber. 1984. *Four Lives in Science: Women's Education in the Nineteenth Century*. New York: Shocken Books.

Burek, Cynthia V. and Bettie Higgs. 2007. *The Role of Women in the History of Geology*. London: Geological Society of London.

Bates, Grace Elizabeth

1914–1996

Mathematician

Education: B.S., Middlebury College, 1935; Sc.M., Brown University, 1938; Ph.D., mathematics, University of Illinois, 1946

Professional Experience: teacher, high school, 1935–1936, 1938–1943; instructor, mathematics, Sweet Briar College, 1943–1944; assistant professor to professor, Mount Holyoke College, 1946–1979

Grace Bates is recognized for her work as a mathematician at a distinguished women's college, Mount Holyoke. As a high school student in the 1920s, Bates had to get special permission as a woman to take advanced mathematics courses. Again, as a student on the women's campus at Middlebury College, she found that the most advanced courses were open only to male students and she had to petition the administration to be able to pursue her mathematics education. She worked as a high school teacher for a year after receiving her undergraduate degree and again taught after receiving her master's degree. She then moved to Sweet Briar College for one year before joining the faculty at Mount Holyoke. She received her doctorate from the University of Illinois, originally intending to study geometry but switching to abstract algebra, working under renowned German mathematician Reinhold Baer. She returned to teach at her alma mater, Mount Holyoke, where she earned tenure and ultimately advanced to full professor. Like many professors at the women's colleges, Bates never married and never had children. She lived and worked on campus until forced to retire in 1979.

Bates was active as both a scholar and a teacher, continuing her education in new mathematical fields to support her teaching. In the 1950s, she spent several summers in Berkeley with Jerzy Neyman, considered by some to be the founder of modern statistics. She ultimately contributed several papers on algebra and probability theory to technical journals and was the co-author of two books, *The Real Number System* (1960) and *Modern Algebra, Second Course* (1963). Among the honors she received was an honorary degree from Middlebury College (1972).

She was a member of numerous professional societies, including the American Mathematical Society and the Mathematical Association of America.

Further Resources

Murray, Margaret Anne Marie. 2000. *Women Becoming Mathematicians: Creating an Identity in Post World War II America*. Cambridge, MA: MIT Press.

Bateson, Mary Catherine

b. 1939

Cultural Anthropologist, Linguist

Education: B.A., Radcliffe College, 1960; Ph.D., Arabic languages, Harvard University, 1963

Professional Experience: associate professor, anthropology, Ateneo de Manila University, 1966–1968; senior research fellow, psychology and philosophy, Brandeis University, 1968–1969; research staff member, Massachusetts Institute of Technology, 1969–1971; visiting professor, anthropology, Northeastern University, 1969–1971 and 1974–1975; researcher, University of Tehran, 1972–1974; professor, anthropology and dean of graduate studies, Damavand College, Tehran, 1975–1977; professor, anthropology and dean of social science and humanities, University of Northern Iran, 1977–1979; visiting scholar, anthropology, Harvard University, 1979–1980; professor, anthropology, Amherst College, 1980–1987, dean of faculty, 1980–1983; Clarence Robinson Professor of Anthropology and English, George Mason University, 1987–2002, Professor Emerita

Concurrent Positions: president, Institute for Intercultural Studies, New York City, 1979–2009; Visiting Scholar, Center on Aging and Work, Boston College, 2006–

Mary Catherine Bateson is a cultural anthropologist whose most recent work, *Full Circles, Overlapping Lives: Culture and Generation in Transition* (2000), is a study of how individuals learn about gender, race, and other social differences through the intergenerational context of the family. For the book, Bateson incorporated research on and life histories of women from a variety of ethnic and economic contexts around the world. Bateson's early interest in anthropology was influenced by her famous parents, the pioneer anthropologists **Margaret Mead** and Gregory Bateson. Her parents had progressive ideas about rearing and educating children, and her mother adopted certain mother–child interactions



Anthropologist Mary Catherine Bateson.
(Steve Liss/Time Life Pictures/Getty Images)

she had observed in primitive societies, such as on-demand breastfeeding, which was not common in the United States in the 1940s.

As a college student at Radcliffe, Bateson met J. Barkev Kassarian, an Armenian student at Harvard, and they married before either of them had completed a doctorate. After graduation, the couple moved to the Philippines, where they both taught at universities. Catherine added anthropology and psychology to her interest in linguistics in order to secure employment. The couple then moved to Iran, where both taught in universities until the political situation became unstable. The couple had a daughter and moved to California for a short time to help Gregory Bateson complete his book, *Mind and Nature* (1979). After several interim appointments, Bateson secured a position in

1980 as professor of anthropology and, later, dean of the faculty at Amherst College. In her book *Composing a Life* (1989), she gives a detailed account of her efforts to open the curricula to new areas of study and to retain more women faculty members. Although she served as a dean for three years at Amherst, she herself experienced discrimination by the college and left in 1987 for a position at George Mason University, where she remained until her retirement in 2002.

Bateson is a member of the American Anthropological Association. She has published numerous scientific papers and received prestigious fellowships from the Ford Foundation (1961–63), the National Science Foundation (1968–69), and Guggenheim (1987–88). In addition to her own autobiographies, information about her early life is included in a biography of her famous parents, *With a Daughter's Eye* (1984).

Further Resources

“Biography.” <http://www.marycatherinebateson.com/bio.html>.

Beall, Cynthia

b. 1949

Anthropologist

Education: B.A., University of Pennsylvania, 1970; M.A., Pennsylvania State University, 1972, Ph.D., anthropology, 1976

Professional Experience: assistant professor to professor, anthropology, Case Western Reserve University, 1976–

Concurrent Positions: founding co-editor, *Journal of Cross-Cultural Gerontology*, 1986–1995

Cynthia Beall is a renowned anthropologist and an authority on how people live at high altitudes. Beall has examined both the physical and the social aspects of people in Tibet, Mongolia, Peru, Bolivia, Nepal, and Ethiopia. Her studies have included such diverse topics as China's birth-control policy in Tibet, the impact of China's reform policy on the nomads, the hemoglobin concentration in people at high altitudes, age differences and sensory and cognitive functions in elderly Nepalese, and the physical fitness of elderly Nepalese farmers.

In *Nomads of Western Tibet: The Survival of a Way of Life* (1990), Beall and co-author M. C. Goldstein present an overview of the life of Tibetan nomads in the years since the Chinese invaded the country in 1950. It is a collection of photographs with a short, nontechnical text, and an article in *National Geographic* (June 1989) summarized their 16-month project. Theirs was the first research team to receive permission to conduct a long-term study of the area since the Chinese invasion. In *The Changing World of Mongolian Nomads* (1994),



Anthropologist Cynthia Beall. (AP/Wide World Photos)

the authors described a three-year study of Mongolia after the death of communism led to the privatization of the nomads' collective farming system. An overview of that study was also published in *National Geographic* (May 1993).

Beall's research has been sponsored by grants from the National Science Foundation, the National Geographic Society, and the American Federation for Aging Research. She is a member of the American Association for the Advancement of Science, American Anthropological Association, American Association of Physical Anthropology, Human Biology Council (president, 1991–1994), Society for the Study of Human Biology, Association for Anthropology and Gerontology, Council for Nutritional Anthropology, and Gerontological Society of America. Beall was elected to the National Academy of Sciences in 1996.

Further Resources

Case Western Reserve University. Faculty website. <http://www.case.edu/artsci/anth/beall.html>.

Beattie, Mollie Hanna

1947–1996

Forester, Government Official

Education: B.A., philosophy, Marymount College, 1968; M.S., forestry, University of Vermont, 1979; M.A., public administration, Kennedy School of Government, Harvard University, 1991

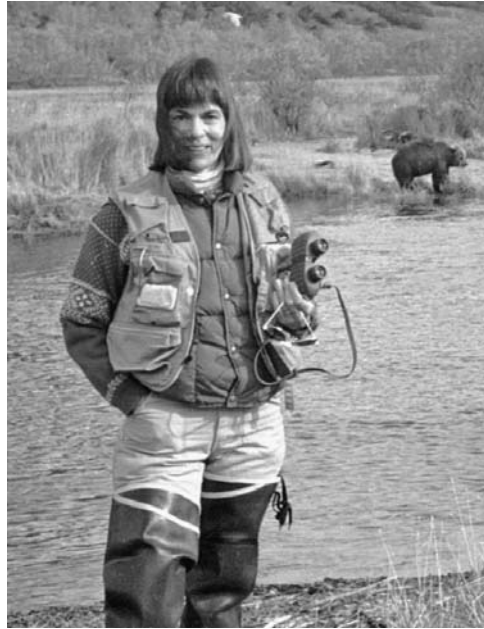
Professional Experience: newspaper reporter; tour guide, Outward Bound, 1974–1976; program director, Windham Foundation, 1983–1985; commissioner of forests and parks, Vermont, 1985–1989; deputy secretary, Vermont Agency of Natural Resources, 1989–1990; executive director, Richard A. Snelling Center for Government, 1991–1993; director, U.S. Fish and Wildlife Service, 1993–1996

Mollie Beattie was the first woman to head the U.S. Fish and Wildlife Service, but unfortunately she served only three years before she died of a brain tumor. Before taking the position with the Fish and Wildlife Service, she was with the Richard A. Snelling Center for Government, a public-policy institute that is now affiliated with the University of Vermont. Its aims are to educate citizens about state and local governments. Her experiences with the Vermont natural resources, forests, and parks agencies prepared her for similar activities on a national level. While

she was head of the Fish and Wildlife Service, her organization enforced wildlife laws, administered the Endangered Species Act, and carried out wetland protection and management.

Beattie was committed to the Endangered Species Act and to environmentalism in her personal life. As a child, she was introduced to nature studies by her grandmother, Harriet Hanna, a self-trained botanist in upstate New York. As an adult, she and her husband lived in a house in the Green Mountains, where they used solar power for their energy requirements, but the noise of the urban environment was still disturbing. In 1993, she published *Working with Your Woodland: A Landowner's Guide*. Professionally, she oversaw the reintroduction of the gray wolf into the

northern Rocky Mountains and won the support of the environmental community when she served as vice chair of a 1991 commission created by the Defenders of Wildlife organization to study the condition and future of the 91-million-acre National Wildlife Refuge System. During her confirmation hearings for the position, some of the senators asked her if she did any hunting. She replied that although she did not hunt, she valued hunters as a major conservation support group and did not see hunting or fishing as incompatible with biodiversity goals. She used the culling of deer in the national parks to prevent the overgrazing of vegetation as an example and said she found biodiversity concepts a good strategy for maintaining wildlife. Her plan to conserve species was to manage the entire ecosystem instead of waiting until individual species became endangered. After her death in 1996, a wilderness area in the Arctic National Wildlife Refuge in Alaska was named in her honor.



Forester Mollie Hanna Beattie was the first woman to head the U.S. Fish and Wildlife Service. (AP/Wide World Photos)

Further Resources

Holmes, Madelyn. 2004. *American Women Conservationists: Twelve Profiles*. Jefferson, NC: McFarland.

Bell, Gwen (Dru'yor)

b. 1934

Geographer, Computer Museum Founder

Education: B.A., University of Wisconsin, Madison, 1955; Master of City and Regional Planning, Harvard University, 1957; Ph.D., geography, Clark University, 1967

Professional Experience: faculty member, Graduate School of Public and International Affairs, University of Pittsburgh, 1966–1973; founder and director, Computer Museum, Boston, 1980–

Gwen Bell has made a unique contribution to the computer industry by founding and directing a museum to house a wide array of computers and components, even including a number of computer games. In addition, she was the first person credited with developing a geographic information system on a computer and with producing a variety of maps. She was first introduced to computers while on Fulbright scholarship in Australia and then used the TX-O at the Massachusetts Institute of Technology to analyze a redevelopment area of Boston.

After receiving her doctorate, she taught in the Graduate School of Public and International Affairs at the University of Pittsburgh. In the 1970s, she worked as a United Nations consultant on planning and edited a journal and three books. Her husband, Gordon Bell, an engineering executive at DEC, was a computer junkie who, along with his wife, had long been collecting computing and calculating artifacts. In 1978, Ken Olsen, president of Digital Equipment Corporation (DEC), asked Bell if the TX-O computer could possibly be rebuilt in DEC headquarters at Marlboro, Massachusetts. This request started Gwen Bell on a project to establish a computer museum, which she did in 1979. As computers have shrunk in size, the museum has been able to include entire machines, like the PDP-1, DEC's first computer, and the Altair of the Massachusetts Institute of Technology. Many of the display items are in working order, especially the personal computers, and older models are loaded with the software that was developed for them. Many of the major exhibits have been designed by local students using their own time and energy to develop lively presentations.

The museum, now called the Computer History Museum and located in Silicon Valley in California, sponsors a number of lectures by computer pioneers each year, and these have been videotaped for use by scholars in the future. A video by Bell entitled "Computer Pioneers and Pioneer Computers" (1996) is available commercially, and many exhibits can be viewed online. Bell is a member of the Association for Computing Machinery (ACM) and served as president of the ACM between 1992 and 1994.

Further Resources

“The Computer History Museum.” <http://www.computerhistory.org/>.

Benedict, Ruth Fulton

1887 1948

Anthropologist

Education: A.B., English, Vassar College, 1909; Ph.D., anthropology, Columbia University, 1923

Professional Experience: lecturer, anthropology, Columbia University, 1924–1930, assistant professor to professor, 1930–1948

Ruth Benedict originated the controversial concept of patterns of culture, which combined anthropology with sociology, psychology, and philosophy. At mid-century, she was recognized along with Frank Boas as one of the country’s leading anthropologists. After receiving her undergraduate degree at Vassar (her mother was also a Vassar graduate and school teacher), she taught school for a few years and then married. Becoming bored with charitable work, in 1919, she enrolled in The New School for Social Research at Columbia University, where she received her doctorate in anthropology in 1923, and where she met and worked with Boas as well as with **Margaret Mead**, with whom she had an intimate relationship. Benedict made her first field trip in 1922 to the Serrano Indians and spent subsequent summers studying other tribes, such as the Zuni Pueblo, Apache, and Blackfoot.

In her 1934 book *Patterns of Culture*, Benedict proposed her holistic theory of culture to explain why certain personalities and types were valued in one society while discouraged in another. In an era of fascism, racism, and ethnic stereotyping for political purposes, Benedict’s theory was controversial because it called for judging each culture only on its own merits and values, and argued that no culture should be forced to conform to the standards or values of another. The book was translated into 14 languages and became a standard anthropology text for many years to come. More controversy surrounded the publication of her 1940 book *Race: Science and Politics*, which took a strong activist tone against racism and was criticized by a politician of the U.S. South. During World War II, she worked for the Office of War Information studying cultures in Japan, Thailand, and New Guinea. This was a new departure for anthropologists, that of analyzing complex modern societies for purposes of politics and national intelligence. This work culminated in her book *The Chrysanthemum and the Sword: Patterns of Japanese*

Culture (1946), a contribution to understanding America's enemy during the war without relying upon stereotypes and racism. The book brought her such renown that in 1947, the Office of Naval Research gave her a large grant to establish and direct a research program on Contemporary Cultures at Columbia, where she was promoted to full professor in what proved to be the last year of her life.

Benedict was a member of the New York Academy of Sciences, president of the American Ethnological Society (1927–1929), vice president of the American Psychopathological Association, and president of the American Anthropological Association (1947); she resigned the latter position due to sexism within the Association at that time. She also served as editor of the *Journal of American Folk-Lore* from 1923 to 1940. Benedict has been the subject of several biographies, beginning with that written by her friend and colleague, Margaret Mead, who published *Ruth Benedict: A Humanist in Anthropology* in 1974.

Further Resources

Banner, Lois W. 2003. *Intertwined Lives: Margaret Mead, Ruth Benedict, and Their Circle*. New York: Random House.

Lavender, Catherine J. 2006. *Scientists and Storytellers: Feminist Anthropologists and the Construction of the American Southwest*. Albuquerque: University of New Mexico Press.

Benerito, Ruth Rogan

b. 1916

Polymer Chemist

Education: B.S., Sophie Newcomb College, 1935; M.S., Tulane University, 1938; Ph.D., chemistry, University of Chicago, 1948

Professional Experience: instructor, chemistry, Randolph-Macon Women's College, Virginia, 1940–1943; assistant professor, Tulane University, New Orleans, Louisiana, 1943–1953; physical chemist, Southern Regional Research Center, U.S. Department of Agriculture (USDA), 1953–1958, head of colloidal chemistry investigation, 1958–1961, head of physical chemistry group, 1961–1986

Concurrent Positions: adjunct professor, chemistry, University of New Orleans; adjunct and emerita professor, Tulane University

Ruth Benerito holds more than 50 patents and is most well-known for her work in the development of the “wash-and-wear” or “permanent press” process for fabrics. Her research was important both in terms of scientific breakthroughs and implications

for commerce and industry. The advent of polyester and other synthetic fabrics threatened the future of cotton textiles, but Benerito's work led to technologies for creating wrinkle-free, stain-free, and even flame-retardant cotton fabrics. She developed a process for soaking cotton in sodium plumbite and heating it to create a slick, clean, "glassy" surface. Her research had an impact not only on the textile industry, but on new wood and paper products as well.

Benerito was a scholar at Bryn Mawr College from 1935 to 1936 and taught at Randolph-Macon Women's College for several years after receiving her master's degree from Tulane University. She moved to Tulane University, where she remained for several years after receiving her doctorate in 1948. She was a scholar at the University of Chicago from 1946 to 1947. In 1953, she joined the USDA, and in 1958 became head of the Cotton Chemical Reactions Laboratory. She then spent more than 30 years at the USDA Southern Regional Research Center in New Orleans, which specializes in the study of cotton and synthetic fabrics due to the textile industry in that region. Benerito had a long career with the USDA as head of several divisions at New Orleans until her retirement in 1986, after which she continued to work as an adjunct professor.

Benerito was twice honored with the USDA's highest award for Distinguished Service (1964 and 1970), and has received numerous other awards for her work, including the Federal Woman Award (1968), Southern Chemist Award (1968), the Garvan Medal (1970), and the Southwest Regional Award of the American Chemical Society (1972). In 2002, she received the Lemelson-MIT Lifetime Achievement Award, and in 2004 was inducted into the USDA's Research Agency's Hall of Fame. She received an honorary degree from Tulane in 1981. She has been a member of the American Association for the Advancement of Science, the American Chemical Society, and the American Association of Textile Chemists and Colorists.



Chemist Ruth Benerito developed a "permanent press" technology for fabrics. (AP/Wide World Photos)

Further Resources

“Ruth Rogan Benerito.” 2000. MIT Inventor of the Week Archive. <http://web.mit.edu/invent/iow/benerito.html>.

Benesch, Ruth Erica (Leroi)

1925–2000**Biochemist**

Education: B.S., University of London, 1946; Ph.D., biochemistry, Northwestern University, 1951

Professional Experience: demonstrator, chemistry, University of Reading, 1945–1947; research associate, chemistry, Johns Hopkins University, 1947–1948; fellow, University of Iowa, 1952, Enzyme Institute, University of Wisconsin, 1955; independent investigator, Marine Biological Laboratory, Woods Hole Oceanographic Institution, 1956–1960; research associate, College of Physicians and Surgeons, Columbia University, 1960–1964, assistant professor to professor, biochemistry and molecular biophysics, 1964–1995, emeritus professor

Ruth Benesch was a collaborator with her husband, Reinhold Benesch, in their research on oxygen transport and other aspects of hemoglobin chemistry. The couple met in London, where Ruth (born in Paris) and her family were in hiding during World War II. She entered the University of London, married Reinhold in 1946, and moved with him to the United States, where both became citizens and received doctorates from Northwestern University. For 40 years, the Benesches conducted research and developed analytical and synthetic methods that allowed the introduction of the thiol groups and an accurate determination of their number in proteins. All but 13 of their 125 published papers dealt with hemoglobin, with special emphasis on its oxygen-carrying capacity. Nearly all the oxygen needed by cells is transported by hemoglobin, and although the normal pressure of oxygen in the lungs ensures complete saturation, or loading, of the hemoglobin, unloading depends not only on oxygen pressure and hemoglobin saturation but also on the oxygen affinity of the hemoglobin. If carbon dioxide accumulates, the affinity decreases and more oxygen is released.

In 1967, the Benesches established that D-2,3-diphosphoglycerate is the third substance necessary for the proper functioning of the oxygen–hemoglobin system. They determined both the site at which diphosphoglycerate and related compounds bind to the protein and the nature of those bonds, and their discoveries resulted in a dramatic change in the way such systems are viewed and studied.

They subsequently researched the cause of sickle-shaped cells in the deadly blood disease sickle-cell anemia. Although other scientists had used x-ray diffraction to study the disease with limited success, the Benesches used electron micron microscopic studies, resulting in significant insights into the formation of sickle cells. Reinhold Benesch died in 1986, and Ruth Benesch remained an active researcher on sickle-cell anemia until her retirement in 1995.

Ruth Benesch was a member of the American Chemical Society, the American Society of Biological Chemists, the Biophysical Society, and the American Society of Hematology.

Benmark, Leslie Ann (Freeman)

b. 1944

Industrial Engineer

Education: B.S., University of Tennessee, 1967, M.S., 1970; Ph.D., information systems, Vanderbilt University, 1976; J.D., University of Delaware, 1984

Professional Experience: systems analyst, Monsanto Company, St. Louis, 1967–1968; systems analyst, E. I. du Pont de Nemours and Company, 1968–1970, systems analysis supervisor, 1970–1975, design supervisor, 1975–1976, planning and industrial engineering supervisor, 1976–1979, business analysis manager, 1979–1987, business strategy manager, 1987–1990, management systems consultant, 1990–1993, global planning manager for integrated processes and systems, 1993–

Concurrent Positions: instructor, computer science, University of Tennessee, 1973–1975; assistant to dean of engineering and director of women engineers program, Vanderbilt University, 1975–1979

Leslie Benmark is known nationally and internationally for her work on the accrediting boards for engineering curricula. Since 1993, she has been the global planning manager for integrated processes and systems for the international Du Pont Company, work that involves long-range strategic planning for global systems. Not all scientists and engineers who work for industrial concerns are engaged in research, as the corporations need people with scientific and technical expertise to work in the entire range of corporate operations. Benmark has always been involved in industrial systems, and she acquired a law degree when she was a business manager for Du Pont.

She has been a member of the accrediting boards for engineering curricula for a number of years, and she works with similar boards in several countries.

For example, she is a fellow of the Institute of Industrial Engineers of Ireland. She is also a member of the National Society of Professional Engineers, the organization that prescribes the curricula for granting professional engineering licenses in the United States. Graduating from an accredited engineering school does not automatically make a person a professional engineer. The person must pass additional coursework and have a specified number of years of experience. In addition to working on the national and international levels, Benmark serves on advisory boards for engineering programs such as those at the Georgia Institute of Technology, New Jersey Institute of Technology, and West Virginia University. She is particularly interested in working with curricula for women engineers. She is also the former chair of the Total Quality Engineering Committee of the Union of Pan-American Associations of Engineering.

Benmark was elected to membership in the National Academy of Engineering in 1993. Among her numerous committee appointments, Benmark has been a member of the Board of Directors of Manufacturing Studies of the National Research Council since 1993, and is a fellow of the Institute of Industrial Engineers and a member of the American Society for Engineering Education. She has been a member of the Industrial Engineering Advisory Board of Oakridge National Laboratory and served as the first female president of the Accreditation Board for Engineering and Technology (ABET) (1990–1991). In 1994, she was the recipient of the Linton E. Grinter Distinguished Service Award from ABET.

Bennett, Joan Wennstrom

b. 1942

Plant Geneticist

Education: B.S., biology and history, Upsala College, New Jersey, 1963; M.S., botany, University of Chicago, 1964, Ph.D., botany, 1967

Professional Experience: National Science Foundation Postdoctoral Fellow, Department of Biology, University of Chicago, 1967–1968; National Research Council Postdoctoral Fellow, U.S. Department of Agriculture, Southern Regional Research Laboratory, New Orleans, Louisiana, 1968–1970; National Science Foundation Postdoctoral Fellow, and assistant professor, biology, Tulane University, New Orleans, Louisiana, 1971–1976, associate professor, biology, 1976–1981, professor, 1981–1990, professor, cell and molecular biology, 1990–2006; professor, plant biology and pathology, and Associate Vice President for Promotion of Women in Science, Engineering, and Mathematics, Rutgers University, 2006–

Concurrent Positions: adjunct professor, pathology, Tulane University School of Medicine, 1982–; visiting scientist, plant molecular biology, Leiden University, Netherlands, 1991–1992; adjunct professor, ecology and evolutionary biology, Tulane University, 1993–; visiting professor, pharmacology, Robert Wood Johnson Medical School, New Jersey, 1998–1999

Joan Bennett is a plant biologist who specializes in fungal genetics, biodegradation and biotechnology, and mycology and mycotoxins, the health and environmental hazards of various molds. She has written or edited numerous books and hundreds of research papers and reviews on the biology and genetics of fungi and molds (mycology), and has taught courses in bioethics and in plant and human genetics and reproduction. Bennett taught biology at Tulane University in New Orleans for 35 years before moving to Rutgers University in New Jersey as professor of plant pathology and an administrative post as Associate Vice President for Promotion of Women in Science, Engineering, and Mathematics in all levels at the university.

Bennett was elected a member of the National Academy of Science in 2005. She holds honorary doctorates from Bethany College and from her alma mater, Upsala College. She is a fellow of the American Association for the Advancement of Science and an honorary member of the Czech Society for Microbiology. She is a member of the American Society for Microbiology (president, 1990), British Mycological Society (vice president, 1988), Louisiana Academy of Sciences, Mycological Society of America, Society for General Microbiology, Society for Industrial Microbiology (president, 2001), and Torrey Botanical Club.

Further Resources

Rutgers University. Faculty website. <http://www.cook.rutgers.edu/~plantbiopath/faculty/bennett/bennett.html>.

Office for the Promotion of Women in Science, Engineering, and Mathematics. Rutgers University. <http://sciencewomen.rutgers.edu/>.

Berenbaum, May Roberta

b. 1953

Entomologist

Education: B.S., Yale University, 1975; Ph.D., ecology and evolutionary biology, Cornell University, 1980

Professional Experience: assistant to associate professor, entomology, University of Illinois, Urbana-Champaign, 1980–1990; professor, entomology and plant biology, 1990–



Entomologist May Berenbaum researches unexplained reductions in the honey bee population. (Ralf-Finn Hestoft/Corbis)

Concurrent Positions: affiliate, Center for Economic Entomology, Illinois Natural History Survey, 1990–

May Berenbaum is an entomologist who specializes in chemical aspects of insect–plant interaction, phototoxicity of plant products, and host-plant resistance, and in 2006 began leading a project in sequencing the “honey bee genome.” Berenbaum has been researching and informing the public on unexplained reductions in the honey bee population, pointing out the critical importance of bees not only for supplies of honey and wax, but for pollination of other plants, flowers, and human food crops. She points out that humans take the contributions of bees for granted

and that the loss of significant numbers of bees could have a devastating economic effect. Theories explaining the disappearance of bees have ranged from parasites to disease to pesticide exposure, but no dead bees have been found to explain the cause. Berenbaum's research could reveal whether bees have a genetic disorder or dysfunction causing them to misnavigate or lose their way to hives.

Berenbaum had a childhood fear of insects that she finally overcame after taking an introductory course in entomology while a freshman at Yale University. She then decided to make them part of her life's work and specialized in insect ecology and evolutionary biology. As part of her efforts to improve the image of insects among the public, Berenbaum hosts an annual Insect Fear Film Festival. While she pointed out in her book *Bugs in the System: Insects and Their Impact on Human Affairs* (1995) that creatures such as lice, mosquitoes, and fleas have caused more deaths than bombs or bullets in human wars, she also shows how humans are dependent on insects for at least a third of the food grown in the world, and for other products such as varnishes and dyes. Other books that Berenbaum has written for the general public are *Ninety-Nine Gnats, Nits, and Nibblers* (1989) and *Ninety-Nine More Maggots, Mites, and Munchers* (1993).

Berenbaum is also concerned with education about career possibilities in the field of entomology, pointing out the multidisciplinary nature of the work of soil scientists, plant pathologists, agricultural economists, microbiologists, animal scientists, and epidemiologists, to name a few. She has received numerous scholarly awards and honors, among them the National Science Foundation's Presidential Young Investigator Award (1984), the Founder's Memorial Award of the Entomological Society of America (1994), the E. O. Wilson Naturalist Award from the American Society of Naturalists (1999), the Silverstein-Simeone Award of the International Society for Chemical Ecology (2000), the Weizmann Institute Women and Science Award (2004), and the MacArthur Award of the Ecological Society of America (2005). She was elected to membership in the National Academy of Sciences in 1994 and named as Associate of the National Academies and National Research Council in 2001. She is a fellow of the American Association for the Advancement of Science, American Academy of Arts and Sciences, American Philosophical Society, and Entomological Society of America, and a member of the American Genetics Association, Ecological Society of America, and International Society of Chemical Ecology.

Further Resources

University of Illinois. Faculty website. <http://www.life.uiuc.edu/entomology/faculty/berenbaum.html>.

Berenbaum, May R. "Losing Their Buzz." *New York Times*. Opinion section. (2 March 2007). <http://www.nytimes.com/2007/03/02/opinion/02berenbaum.html>.

Berezin, Evelyn

b. 1925

Computer Scientist, Physicist

Education: B.S., physics, New York University (NYU), 1951**Professional Experience:** design engineer, Electronic Computer Corporation and Underwood Corporation, 1951–1957; logic designer, Teleregister Corporation, 1957–1960; manager, logic design, Digitronics Corporation, 1960–1969; founder and president, Redactron Corporation, 1969–1978; president, office products, Burroughs Corporation, 1978–1980; founder and president, Greenhouse Management Corporation, 1980–1987; consultant, 1988–

Evelyn Berezin was a pioneer in computer hardware design with her development of the first office computer in the 1950s and with the first word processor to replace the typewriter in the 1960s. She was also an innovator in the uses of interactive computer programs and also helped develop the first computer data systems for banks and then for the first airline reservation system, which was used by United Airlines. She envisioned using the word processor as a tool for creating and editing text documents, and in 1969, she and two colleagues founded their own firm, Redactron, to design and manufacture a product called Data Secretary. They were second only to IBM in producing word processors, but were forced to sell the company to Burroughs Corporation in 1978, who failed to market her machine for office use. Several other companies, notably IBM, would corner the office word-processing market that took off in the 1980s.

Berezin was a business major in college until an unexpected job offer prompted her to switch to physics. She planned to go on for a doctorate, and held a fellowship from the Atomic Energy Commission while a student at NYU, but instead obtained a job with Electronic Computer Corporation. She designed computer systems and received patents on several individual components. After selling Redactron to Burroughs Corporation in 1978, Berezin became the president of that company's office products group. However, she left in 1979 to form her own firm again, this time a consultant firm for the automation industry. Later, she formed Greenhouse Management Corporation, a venture capital group that invested in high-technology companies. Since 1988, she has been an independent management consultant and has served on the board of directors for numerous technology research organizations and corporations, including Sion Power Corporation and IntelliCheck, Inc.

Berezin has received honorary doctorates from Adelphi University and Eastern Michigan University. She was acknowledged as an inventor with her 2006 induction into the Long Island Technology Hall of Fame.

Further Resources

Rostky, George. 2000. "The Word Processor: Cumbersome, but Great." *EE Times*. http://www.v2.eetimes.com/special/special_issues/millennium/milestones/berezin.html.

Berger, Marsha J.

b. 1953

Computer Scientist

Education: B.S., mathematics, State University of New York, Binghamton-Harpur College, 1974; M.S., computer science, Stanford University, 1978, Ph.D., computer science, 1982

Professional Experience: programmer, Energy and Environmental Systems Division, Argonne National Laboratory, 1974–1976; consultant and program librarian, Stanford Linear Accelerator Center (SLAC) and Stanford Center for Information Processing (SCIP), and teaching and research assistant, computer science, 1976–1982; postdoctoral fellow, Courant Institute of Mathematical Sciences, New York University, 1982–1984, associate to assistant professor, computer science, 1985–1993, deputy director, Courant Institute, 1997–2003 and fall 2005, professor, 1993–

Concurrent Positions: research assistant, Mathematics Division, IBM T. J. Watson Research Center, 1978; research assistant, Computation Group, Lawrence Livermore National Laboratory, 1979; scientist in residence and consultant, Institute for Computer Applications in Science and Engineering (ICASE), NASA Langley Research Center, summers, 1983, 1984, 1985; visiting scientist, NASA Ames Research Center, 1991–1992, 2003–2005, summers, 1993–

Marsha J. Berger is a computer scientist whose research interests include computational fluid dynamics, numerical analysis, and high-performance parallel computing, specifically developing software and engineering applications for the aircraft and spacecraft industries. After receiving her bachelor's degree in mathematics, she worked as a scientific programmer for Argonne National Laboratory, where she developed models for the Energy and Environmental Systems Division. She pursued graduate study at Stanford University and was affiliated with the Stanford Linear Accelerator Center. After receiving her Ph.D. in computer science from Stanford in 1982, she joined the faculty of the Courant Institute of Mathematical Sciences at New York University, where she has taught for more than 20 years. She has also served as deputy director of the Courant Institute.

Berger was elected to the National Academy of Sciences in 2000 and the National Academy of Engineering in 2005. She has also received the Presidential Young Investigator Award of the National Science Foundation (NSF) (1988), a Faculty Award for Women from the NSF (1991), the NASA Software of the Year Award for Cart3D (2002), and the Sidney Fernbach Award of the IEEE (2004). She is a member of the Society for Industrial and Applied Mathematics, American Mathematical Society, Association for Women in Mathematics, and American Institute for Aeronautics and Astronautics.

Further Resources

New York University. Faculty website. <http://as.nyu.edu/object/MarshaBerger.html>.

Berkowitz, Joan B.

b. 1931

Physical Chemist

Education: B.A., Swarthmore College, 1952; Ph.D., physical chemistry, University of Illinois, 1955; certificate, Senior Executive Program, Sloan School, 1977

Professional Experience: National Science Foundation fellow, Yale University, 1955–1957; physical chemist, Arthur D. Little, Inc., 1957–1980, vice president and section head of Environmental Business World Wide, 1980–1986; chief executive officer (CEO), Risk Science International, 1986–1989; founder and managing director, Farkas, Berkowitz & Company, Inc., 1989–

Concurrent Positions: adjunct professor, physical chemistry, Boston University, 1965–1970; adjunct professor, University of Maryland

Joan Berkowitz is internationally known as an authority on environmental hazards. After receiving her undergraduate degree from Swarthmore, she wanted to study physical chemistry at Princeton University; however, the Princeton Chemistry Department would not accept women graduate students, so she completed her graduate studies at the University of Illinois in three years and then held a National Science Foundation fellowship at Yale University. She accepted a position as a physical chemist at Arthur D. Little, Inc., an international management and technology consulting firm, while her husband, Arthur Mattuck, joined the mathematics faculty at the Massachusetts Institute of Technology.

At Little, Berkowitz was very successful with high-temperature oxidation studies, which led to opportunities for projects in hazardous waste disposal. After she

had worked for about 20 years, the company funded her participation in the Senior Executive Program of the Sloan School. In 1980, she became a vice president of Little and was further promoted to head the section Environmental Business World Wide. In 1986, she became the CEO of Risk Science International, a consulting firm in Washington, D.C. In 1989, she teamed with Allen Farkas to form Farkas, Berkowitz and Company to consult on waste treatment and disposal, remediation technologies, and market potential assessment. She headed a team that produced a multivolume catalog of all possible manufactured products with any potential to cause pollution problems. She also investigated the problem of “scrubbing,” a technique in which sulfur dioxide is removed from the air to improve air quality.

Her research programs in electrochemistry, high-temperature chemistry, solar energy, and environmental science are all areas of interest to the space program. She developed a major research program in high-temperature oxidation of transition metals that showed that molybdenum disilicide had the greatest oxidation resistance at all temperatures and was also the most corrosion-resistant. The plating techniques using molybdenum disilicide that the National Aeronautics and Space Administration (NASA) developed were used in industry also. Other related projects involved mechanisms of oxidation reactions in gas streams, studies of radiation shields, and the use of electrical fields to retard high-temperature oxidation of metals and alloys.

Berkowitz was the first woman president of the Electrochemical Society (1979–1980), and she is also a member of the American Chemical Society and the American Physical Society. She received the Achievement Award of the Society of Women Engineers (1983) for her pioneering contributions in the field of hazardous waste management.

Further Resources

“Farkas Berkowitz & Company: Catalyst for Change.” <http://www.farkasberkowitz.com/>.

Bertell, Rosalie

b. 1929

Biomathematics

Education: B.A., mathematics, D’Youville College, 1951; M.A., mathematics, Catholic University of America, Washington, D.C., 1959, Ph.D., biometrics, 1966

Professional Experience: assistant, mathematics, Catholic University, 1957–1958; associate professor, mathematics, Sacred Heart Junior College, Pennsylvania, 1958–1968; coordinator of high school math teachers, D’Youville Academy,

Atlanta, Georgia, 1968–1969, coordinator and associate professor, mathematics, D’Youville College, 1969–1972; visiting professor, State University of New York, Buffalo, 1972–73, assistant research professor, 1974–1978; director and research consultant, Ministry of Concern for Public Health, New York, 1978–1980; Energy and Public Health specialist, Jesuit Centre for Social Faith and Justice, Toronto, Ontario, Canada, 1980–1984; faculty, Ovum Pacis: The Women’s Peace University, USA and Canada, 1994–; founder and president, International Institute of Concern for Public Health, 1987–2001

Concurrent Positions: senior research scientist, Roswell Park Memorial Institute, 1970–1978; cancer research scientist and consultant, 1975–1980

Rosalie Bertell has studied and been an activist raising awareness about the hazards of low-level radiation of nuclear energy. Her research involves mathematical statistics, analysis, measure theory, the aging effect in humans associated with exposure to ionizing radiation, updating relative risk methodology for biomedical applications, and lifestyle and chronic diseases. She has created controversy by arguing that standard research methods on nuclear energy are aimed to convince people that low-level radiation is harmless. She argues, however, that there are no peaceful uses of atomic energy because it leads to either a quick death from atomic weapons or a slow death from the pollution emanated by atomic production. Radiation increases not only the risk of cancer, but also susceptibility to infectious diseases and risk of earlier onset of heart disease, diabetes, arthritis, coronary-renal disease, and other chronic health problems. At the time the first nuclear tests were conducted, scientists did not have sufficient data to anticipate what some of the results would be. However, there still is not a consensus on how the data should be interpreted.

Bertell has published widely on this issue, with numerous articles, pamphlets, and books such as *No Immediate Danger: Prognosis for a Radioactive Earth* (1985), which was the first to discuss the dangers of low-level radiation, and *Planet Earth: The Latest Weapon of War, A Critical Study into the Military and the Environment* (2001). She was also editor of the journal *International Perspectives in Public Health*. She has also written on the dangers of depleted uranium, the effect of x-rays, the toxic waste created by military operations, and Gulf War syndrome. On these issues and others, she has consulted for numerous educational, government, and human-rights groups, such as the Environmental Protection Agency, the Energy Task Force of the National Council of Churches, the Citizens’ Advisory Committee to the President’s Commission on Three Mile Island, and International Medical Commissions to deal with nuclear accidents, such as in Chernobyl in the late 1990s.

Bertell has been acknowledged for her scientific activism against nuclear weapons and for human rights. In 1986, she received the Right Livelihood Award “[f]or raising public awareness about the destruction of the biosphere and human gene

pool, especially by low-level radiation.” In 1993, she received official recognition from the United Nations Environmental Programme (UNEP) and was named to UNEP’s Global 500 Roll of Honour. Among her other awards and honors are the World Federalist Peace Award, a Health Innovator Award of the Ontario Premier’s Council on Health, the Sean MacBride International Peace Prize, and selection (in 2005) as one of 1,000 PeaceWomen nominated for the Nobel Peace Prize. She has received several honorary doctorates and is a member of the Health Physics Society, American Academy of Political and Social Science, American Public Health Association, and International Biometric Society. She conducts her work through the International Institute of Concern for Public Health (IICPH), a Toronto, Canada–based organization she founded in 1984. She is also a founding member of the International Commission of Health Professionals, the International Association of Humanitarian Medicine, and the Commission of Health Professionals.

Further Resources

International Institute of Concern for Public Health. <http://www.iicph.org>.

Blackburn, Elizabeth

b. 1948

Cell Biologist

Education: B.Sc., biochemistry, University of Melbourne, Australia, 1970, M.Sc., biochemistry, 1972; Ph.D., molecular biology, University of Cambridge, England, 1975

Professional Experience: postdoctoral fellow, molecular and cell biology, Yale University, 1975–1977; postdoctoral fellow, University of California, San Francisco, 1978; assistant professor, molecular biology, University of California, Berkeley, 1978–1983, associate professor, 1983–1986, professor, 1986–1990; professor, biochemistry and biophysics, and microbiology and immunology, University of California, San Francisco, 1990–

Elizabeth Blackburn is a cell biologist whose work has contributed to cancer research and who shared the 2009 Nobel Prize in Physiology or Medicine with her former student **Carol Greider** and colleague Jack Szostak. Blackburn’s research focuses on telomerase enzyme research and the molecular nature of telomeres, the ends of chromosomes that cover and protect genetic information. The role of telomerase is important for advances in cancer research since it helps explain how cells form, age, replicate, and mutate. Blackburn’s lab studies cells



Cell biologist Elizabeth Blackburn, co-recipient of the 2009 Nobel Prize in Physiology or Medicine. (© The Nobel Foundation. Photo: Ulla Montan)

from a variety of organisms, including humans. In 2001, Blackburn was elected a member of the President's Council on Bioethics, but her support for stem-cell research led to her controversial removal from the council in 2004. Her removal, and the Bush administration's moratorium on stem-cell research, prompted outrage from the scientific community. She serves on the Science Advisory Board of the Genetics Policy Institute.

Born in Australia, Blackburn received degrees in biochemistry from the University of Melbourne and went on to earn her doctorate in molecular biology from the University of Cambridge in England. She came to the United States in 1975 as a postdoctoral fellow at Yale and moved to California in 1978 to join the faculty at Berkeley. She moved to the University of California, San

Francisco in 1990, where she is currently the Morris Herztein Professor of Biology and Physiology and holds joint appointments in the departments of Biochemistry and Biophysics and of Microbiology and Immunology, serving as department chair between 1993 and 1999.

Blackburn has received honorary doctorates from several prestigious American universities, including Harvard, Yale, Princeton, and others. A select listing of her numerous other awards and honors includes the Eli Lilly Research Award for Microbiology and Immunology (1988), National Academy of Sciences Award in Molecular Biology (1990), Gairdner Foundation International Award (1998), Clowes Memorial Award of the American Association for Cancer Research (2000), Medal of Honor of the American Cancer Society (2000), AACR-Pezcoller Foundation International Award for Cancer Research (2001), Alfred P. Sloan Award of the General Motors Cancer Research Foundation (2001), E. B. Wilson Award of the American Society for Cell Biology (2001), Albert Lasker Award for Basic Medical Research (2006) (shared with future Nobel Laureate colleagues, Greider and Szostak), and L'Oréal-UNESCO Award for Women in Science (2008).

Blackburn formalized her American citizenship in 2003. She was elected a Foreign Associate of the National Academy of Sciences (1993) and a member of the Institute of Medicine (2000), and is a fellow of the American Association for the Advancement of Science, American Academy of Microbiology, Royal Society of London, Australian Academy of Science, and American Academy of Arts and Sciences. She is also a member of the Genetics Society of America and American Society for Cell Biology (president, 1998).

Further Resources

University of California, San Francisco. Faculty/lab website. http://biochemistry.ucsf.edu/labs/blackburn/index.php?option=com_content&view=article&id=1&Itemid=3

“Elizabeth H. Blackburn: Interview.” http://nobelprize.org/nobel_prizes/medicine/laureates/2009/blackburn-interview.html.

Bliss, Eleanor Albert

1899–1987

Bacteriologist

Education: A.B., Bryn Mawr College, 1921; Sc.D., Johns Hopkins University, 1925

Professional Experience: fellow, medicine, Johns Hopkins University, 1925–1935, faculty, 1936–1952; advisor, U.S. Army Chemical Corps, 1945–1952; professor, biology and dean of graduate school, Bryn Mawr, 1952–1966

Concurrent Positions: board member, University of Pennsylvania, 1954–1959

Eleanor Bliss was an authority on the use of sulfa drugs, and her discovery of group F streptococcus led to the first medicine to cure strep infection. Bliss and her colleague, Dr. Perrin H. Long, conducted animal and then human trials for sulfa drugs before the first human case was cured in 1936. They presented their work on drug chemical therapy of bacterial infections at conferences and in journal articles before publishing their findings in a 1939 book, *Clinical and Experimental Use of Sulfanilamide, Sulfapyridine and Allied Compounds*. Although much attention was paid to the use of sulfa drugs in treating streptococcus (especially after the president’s son, Franklin Delano Roosevelt, Jr., was successfully cured in late 1936), in the book they outlined a wide range of illnesses and diseases that could be treated with the drugs, such as gonorrhea, pneumonia, kidney infections, and streptococcal meningitis, which previously was nearly always fatal.

Even though many of these drugs have since been replaced with other medications, Bliss's findings for therapeutic uses for sulfa drugs preceded the discovery of penicillin by more than a decade.

The work of Bliss and Long was supported in part by the Chemical Foundation, an American organization that was racing to develop new medicines and cures before German or other European countries. Sulfa drugs were used extensively for the first time during World War II to treat the wounds of soldiers. The historical and scientific importance of Bliss's work as a bacteriologist, which prompted a decades-long revolution in pharmaceutical research, is detailed in a recent book by John E. Lesch, *The First Miracle Drugs: How the Sulfa Drugs Transformed Medicine* (2007).

Bliss served on the faculty of Johns Hopkins University for 16 years, taking a leave of absence to work with the Chemical Corps during the war years. After the war, she accepted an appointment as professor of biology and dean of the graduate school at Bryn Mawr College. She was elected a fellow of the American Academy of Microbiology and of the American Association for the Advancement of Science. She was a member of several professional societies, including the American Society of Bacteriologists and the American Association of Immunologists.

Further Resources

Lesch, John E. 2007. *The First Miracle Drugs: How the Sulfa Drugs Transformed Medicine*. New York: Oxford University Press.

Blodgett, Katharine Burr

1897–1979

Physicist

Education: A.B., Bryn Mawr College, 1917; S.M., University of Chicago, 1918; Ph.D., physics, Cambridge University, 1926

Professional Experience: research physicist and chemist, General Electric Company, 1918–1924, 1926–1962

Katharine Blodgett was a physicist most notable for her invention of nonreflecting glass. She developed methods for constructing and measuring the thickness of films, and her discovery that stacking thousands of layers of film together would neutralize light coming through glass was announced in 1938. Her early research on the ability of activated charcoal to absorb gases was important to the design of gas masks during World War I. Blodgett's work had applications for another

later war effort when, during World War II, she researched ways to de-ice airplane wings and developed a method for military weather balloons to measure air humidity.

After receiving her master's degree, Blodgett was the first woman research scientist hired by General Electric (GE) in Schenectady, New York, where she worked with chemist Irving Langmuir. Until she received her Ph.D., she did not always receive credit on papers she co-authored with Langmuir, who received the Nobel Prize for Chemistry in 1932. Langmuir did, however, thank her in his writings for "carrying out most of the experimental work." Through Langmuir's influence, she was encouraged to pursue a doctorate and was

able to obtain a position at Cavendish Laboratory, which resulted in her being the first woman to receive a Ph.D. in physics from Cambridge.

After she completed her doctorate, she returned to GE to work with Langmuir on problems with tungsten filaments in lamps and efforts to improve one of GE's main products, light bulbs. Langmuir and Blodgett collaborated in developing a process of building up film layers for use in nonreflective glass and optical coatings not only for eyeglasses, but also for camera lenses, televisions, and computer monitors. Their discovery, which became known as Langmuir-Blodgett films, attracted attention outside of scientific circles because of the possible consumer applications and was reported in popular magazines such as *Time*, *Look*, and *Life*. Although Blodgett received early attention for her role as a woman scientist at GE, by 1953, an article celebrating the seventy-fifth anniversary and achievements of the GE laboratory did not even mention her name.

Blodgett received recognition in the form of an Annual Achievement Award of the American Association of University Women (1945), a Garvan Medal of the American Chemical Society (1951), and the Progress Medal of the Photographic Society of America (1972). She also received honorary degrees from Elmira College (1939), Brown University (1942), Western College (1942), and Russell Sage College (1944). She was elected a fellow of the American Physical Society and was a member of the Optical Society of America.



Physicist Katharine B. Blodgett. (Time & Life Pictures/Getty Images)

Further Resources

Byers, Nina and Gary A. Williams. 2006. *Out of the Shadows: Contributions of Twentieth-Century Women to Physics*. New York: Cambridge University Press.

Bonta, Marcia (Myers)

b. 1940

Naturalist

Education: B.A., Bucknell University, 1962

Professional Experience: independent naturalist and author

Marcia Bonta is renowned as a writer on nature subjects, primarily in the state of Pennsylvania. She has contributed greatly to the history of nature writing with her books *Women in the Field: America's Pioneering Women Naturalists* (1991) and *American Women Afield: Writings by Pioneering Women Naturalists* (1995), studies of early women naturalists of the late nineteenth and early twentieth centuries when women scientists had fewer professional opportunities. Bonta spent much of her time walking and observing in the woods, and began looking for women in past generations who were observers of the natural world. Based on archival research from around the United States, she gathered together previously unavailable stories of these women's lives. Her first book chronicled her own family's experience of wilderness living, *Escape to the Mountain* (1980; reprinted, 2008). She has also written several books about her native Pennsylvania, including *Outbound Journeys in Pennsylvania* (1988; Book of the Year award from Pennsylvania Outdoor Writers Association), *Appalachian Spring* (1991), *Appalachian Autumn* (1994), *More Outbound Journeys in Pennsylvania* (1995), *Appalachian Summer* (1999), and *Appalachian Winter* (2005). She was editor of a "Series on Nature and Natural History" by the University of Pittsburgh Press (1990–1998). She has also published more than 300 articles in state and national magazines, including a long-standing monthly column, "Naturalist's Eye," for the *Pennsylvania Game News*, which she has written since 1993.

Bonta considers herself a naturalist first and a writer second. She calls herself "a missionary for the natural world," and calls attention to the spiritual and ecological effects of development, inspiring people to think about nature and the outdoors as having more than a recreational purpose. She has been a member of the Pennsylvania Outdoor Writers Association and the Juniata Valley Audubon Society (vice president, 1983–1984; president, 1984–1988).

Further Resources

“Marcia Bonta: Naturalist Writer.” <http://marciabonta.wordpress.com/>.

Boring, Alice Middleton

1883 1955

Zoologist

Education: B.A., Bryn Mawr College, 1904, M.A., 1905, Ph.D., 1910

Professional Experience: instructor, biology, Vassar College, 1907–1908; instructor, zoology, 1911, University of Maine, assistant professor, 1911–1913, associate professor, 1913–1918; assistant professor, biology, Peking Union Medical College, 1918–1920; professor, zoology, Wellesley College, 1920–1923; professor, zoology, Yenching University, 1923–1943, 1946–1950; instructor, histology, College of Physicians and Surgeons, Columbia University, 1943–1944; visiting professor, zoology, Mount Holyoke, 1945–1946; part-time professor, zoology, Smith College, 1951–1953

Alice Boring was a zoologist who made significant contributions to the literature on the taxonomy of Chinese amphibians and reptiles, many of which at that time were unknown to researchers in the United States and Europe. She contributed to the spread of scientific knowledge by teaching Chinese students and by collecting data and specimens of Chinese animals. She also published several scientific papers in journals such as the *Hong Kong Naturalist* and *Peking Natural History Bulletin*. Born and educated in Pennsylvania, Boring spent a major portion of her career outside the United States. During her doctoral studies on insect genetics at Bryn Mawr, she studied at the University of Wurzburg and the Naples Zoological Station. She then spent about 10 years on the faculties of Vassar and the University of Maine, attaining the position of associate professor at the latter institution. Her early research involved cytology and genetics, and she seemed to be headed for a traditional career in academia. Between 1918 and 1950, however, Boring remained primarily in China, teaching biology and conducting zoological research at Peking Union Medical College and, later, at Peking (Yenching) University. During this time, she witnessed civil war, revolution, the Japanese occupation, World War II (involving her internment and repatriation), and the creation of a new socialist society in China.

After her first two-year term in China, Boring made it her mission in life to stay in that country to teach. She immediately involved herself in Chinese educational

and political causes. She was repatriated from China in 1943 after spending two years with British and American citizens in a concentration camp after their university was shut down. She held teaching posts at Columbia University's medical college and at Mount Holyoke, but she eagerly returned to the country she loved in 1946 for four additional years. She returned to the United States in 1951 when a family member became ill and taught briefly at Smith College.

Further Resources

Ogilvie, Marilyn Bailey. 1991. "The 'New Look' Women and the Expansion of American Zoology: Nettie Maria Stevens (1861–1912) and Alice Middleton Boring (1883–1955)." In *The Expansion of American Biology*, edited by Keith R. Benson et al., 52–79. New Brunswick, NJ: Rutgers University Press.

Ogilvie, Marilyn Bailey and Clifford J. Choquette. 1999. *A Dame Full of Vim and Vigor: A Biography of Alice Middleton Boring, Biologist in China*. Amsterdam: Harwood Academic Publishers.

Boyd, Louise Arner

1887–1972

Geographer, Explorer

Education: private schools

Professional Experience: scientific explorations of polar regions

Louise Boyd contributed to science by sponsoring and leading expeditions of scientifically trained personnel who made significant contributions to our knowledge of the Arctic. During World War II, she was a consultant to the U.S. War Department due to her experience in exploring the polar regions. Since the Danes and the Norwegians had conducted the primary polar research, her files of notes, maps, photographs, botanical specimens, and so on were the only American sources available. She was a wealthy woman who first saw polar ice on a vacation with friends in 1926. She sponsored six additional trips to Arctic regions, primarily to east Greenland, where an area, Louise Boyd Land, was named after her. Although she was not a scientist, she provided the best equipment available to the scientists who accompanied her, and she consulted with the staff of the American Geographical Society in selecting both the scientists and the equipment. She trained herself to be an expert photographer and developed skill in collecting botanical specimens. In 1955, she was the first woman to fly over the North Pole, and in 1960, she became the first woman councilor of the American Geographical Society.

Boyd's published works included *The Fiord Region of East Greenland* (1935), which detailed the scientific results of her 1931 and 1933 trips, and *The Coast of Northeast Greenland* (1948), both published by the American Geographical Society. She also published *Polish Countrysides* (1937), which recorded her trip to Warsaw for the International Geographical Congress. She was a delegate to the Congress, representing the U.S. government and the American Geographical Society. She had exceptional leadership skills, which made her the only woman to achieve an outstanding position in Arctic exploration. She received honorary degrees in 1939 from both the University of California and Mills College.

Further Resources

Olds, Elizabeth F. 1985. *Women of the Four Winds: The Adventures of Four of America's First Women Explorers*. Boston: Houghton Mifflin.

Braun, Annette Frances

1884 1978

Entomologist

Education: A.B., University of Cincinnati, 1906, A.M., 1908, Ph.D., zoology, 1911

Professional Experience: assistant, zoology, University of Cincinnati, 1911–1916; private research, 1916–1978

Annette Braun was an eminent entomologist and a leading authority on Lepidoptera, particularly Microlepidoptera, the order that includes butterflies and moths. She was the first woman granted a Ph.D. at the University of Cincinnati. After receiving her doctorate, she remained affiliated with the university for about five years before she left to engage in private research. She was considered a prominent entomologist of her time and was elected vice president of the Entomological Society of America in 1926. She and her sister, **Lucy Braun**, who taught botany at the University of Cincinnati, maintained a research garden famous for its unusual plants, and Annette traveled with her sister on botanical expeditions in Ohio and Kentucky. The Braun sisters were committed to the preservation of natural resources and local environments, and Annette Braun was a lifetime trustee of the Cincinnati Museum of Natural History, which now includes a Braun library and archives of Lucy Braun's manuscripts. Annette Braun's notes and an extensive collection of more than 5,000 slides were donated to the Smithsonian Institution, and her mounted collection of nearly 30,000 specimens of moths was given to the Philadelphia Academy of Science.

Braun published numerous papers on moths for the American Entomological Society and other scientific journals, published four monographs and books, and provided detailed illustrations for her studies based on her own observations and use of a microscope to study insects. She continued to research and publish significant work well into her eighties, and died at the age of 94.

Further Resources

Bonta, Marcia M. 1991. *Women in the Field: America's Pioneering Women Naturalists*. College Station: Texas A&M University Press.

Ohio State University. Obituary. https://kb.osu.edu/dspace/bitstream/1811/22633/1/V079N4_189.pdf.

Braun, (Emma) Lucy

1889–1971

Botanist

Education: A.B., University of Cincinnati, 1910, A.M., geology, 1912, Ph.D., botany, 1914

Professional Experience: assistant, geology, University of Cincinnati, 1910–1913, assistant, botany, 1914–1917, instructor, botany, 1917–1923, assistant to associate professor, botany, 1923–1946, professor, plant ecology, 1946–1948

Lucy Braun was a botanist instrumental in developing the scientific discipline of ecology in the United States. She took early retirement from the University of Cincinnati only two years after achieving full professorship to devote her time to fieldwork, particularly in Ohio. She was often accompanied on her botanical field expeditions by her sister, entomologist **Annette Frances Braun**, work the sisters continued well into their eighties. In the 1920s and 1930s, Lucy Braun cataloged the flora of the Cincinnati area and compared it with the flora of the same region 100 years earlier. One of the first studies of its type in the United States, this provided a model for comparing changes in flora over a span of time. Braun's research and exhaustive cataloging of native plant life led to the preservation of tens of thousands of acres in her native Ohio and established ecology as an academic discipline. Thirty years after her death, her ecological legacy is still honored through a summer workshop in Kentucky entitled "In the Footsteps of Lucy Braun," which leads participants through local forests to show the decimation caused by mining.

Braun published hundreds of papers as well as books such as *An Annotated Catalog of the Spermatophytes of Kentucky* (1943), *The Woody Plants of Ohio* (1961; commissioned by the Ohio Academy of Science), and various studies on plants new to science in Ohio and Kentucky. She is best known, however, for her 1950 book *Deciduous Forests of Eastern North America*, still considered an authoritative reference work on the subject. In it she coined the term “mixed mesophytic” to describe the thick forests of the American Southeast that are made up of a variety of tree species, many of them ancient. In 1917, she founded the Wildflower Preservation Society and served as editor of its journal, *Wildflower*, between 1928–1933. She was the first female president of both the Ohio Academy of Science (1933–1934) and the Ecological Society of America (1950), and was the first woman inducted into the Ohio Conservation Hall of Fame (1971). Among her awards and honors were the Mary Soper Pope Medal in botany (1952) and the Certificate of Merit of the Botanical Society of America (1956).

Further Resources

Bonta, Marcia M. 1991. *Women in the Field: America's Pioneering Women Naturalists*. College Station: Texas A&M University Press.

Western Kentucky University. Biography. <http://www.wku.edu/~smithch/chronob/BRAU1889.htm>.

Ohio Valley Environmental Coalition. “Forests, Firsthand: Workshops Show Richness Eastern Kentucky Retains, What It's Lost.” [http://www.ohvec.org/links/news/archive/2007/fair use/06 11.html](http://www.ohvec.org/links/news/archive/2007/fair%20use/06%2011.html).

Bricker, Victoria (Reifler)

b. 1940

Anthropologist, Ethnologist

Education: B.A., philosophy and humanities, Stanford University, 1962; M.A., anthropology, Harvard University, 1963, Ph.D., anthropology, 1968

Professional Experience: visiting lecturer, anthropology, Tulane University, 1969–1970, assistant professor to professor, anthropology, 1970–

Concurrent Positions: book review editor, *American Anthropologist*, 1971–1973; editor, *American Ethnologist*, 1973–1976

Victoria Bricker is an ethnologist and anthropologist who specializes in comparing the oral tradition with the written history of Mexico. Bricker was born in Hong

Kong and moved to the United States as a young child, eventually attending both Stanford and Harvard Universities. Her research and publications relate to the Dresden Codex and the Madrid Codex, original manuscripts that describe the history and culture of the Mayans. The Maya developed a type of pictogram called *glyphs* in which they recorded events on buildings, monuments, and tree bark. When the Spaniards conquered the Maya, they melted the gold and silver ornaments, and the Spanish priests destroyed many written records, although much writing remained on buildings and monuments, and some of the manuscripts written on tree bark were saved and eventually ended up in archives in Europe. The Dresden Codex contains astronomical calculations, and the Madrid Codex contains information on astrology and divination practices. One area in which Bricker specializes is the astronomical records maintained by the Maya on their calendars.

She has published numerous papers and journal articles, as well as books, including *The Indian Christ, the Indian King: The Historical Substrate of Maya Myth and Ritual* (1981) and *A Grammar of Mayan Hieroglyphs* (1986). Since 1977, she has served as the general editor of *Supplement to Handbook of Middle American Indians*. Bricker was elected to the National Academy of Sciences in 1991. She is a fellow of the American Philosophical Society and a member of the American Anthropological Association, American Society for Ethnohistory, Linguistic Society of America, and Société des Americanistes.

Brill, Yvonne (Claeys)

b. 1924

Aerospace Engineer, Chemist

Education: B.Sc., University of Manitoba, 1945; M.S., University of Southern California, 1951

Professional Experience: mathematician, aircraft design, Douglas Aircraft Company, 1945–1946; research analyst, propulsion and propellants, Rand Corporation, 1946–1949; group leader, igniters and fuels, Marquardt Corporation, 1949–1952; staff engineer, combustion, United Technology Corporation, 1952–1955; project engineer, preliminary design, Wright Aeronautical Division of Curtiss-Wright Corporation, 1955–1958; consultant, propulsion and propellants, FMC Corporation, 1958–1966; manager, propulsion, RCA Astro-Electronics, 1966–1981, staff

engineer, preliminary design, 1983–1986; manager, solid rocket motor, National Aeronautics and Space Administration (NASA) headquarters, 1981–1983; staff member and space engineer, International Maritime Satellite Organization, 1986–1991; consultant, 1991–

Yvonne Brill has been involved in the aerospace industry both in the United States and England during her entire professional career, specializing in both liquid and solid rocket propulsion. She developed new rocket-propulsion systems for communication satellites; the single-propellant rocket system, the hydrazine/hydrazine resistojet, which she developed in 1974 and for which she holds the patent, is still in use today. Brill was born in Canada, but after receiving her undergraduate degree in mathematics, she was unable to find work in Canada and began graduate studies in California after accepting a position at Douglas Aircraft as a mathematician assisting with studies of aircraft propeller noise. She received her master's degree in 1951 and held positions with several U.S. companies over the course of her career, including researching rocket and missile designs and propellant formulas at Rand, working as a staff engineer with United Technology Research Laboratory to study rocket and ramjet engines, and developing high-energy fuels for advanced aircraft at Curtiss-Wright. After the birth of her children, she worked as a part-time consultant on rocket propellants for FMC Corporation.

Returning to full-time work in 1966, Brill was employed at RCA Astro-Electronics (now GE Astro), as a senior engineer and then manager of NOVA propulsion. It was at RCA that she developed a hydrazine/hydrazine resistojet thruster, which was a monumental advance for single-propellant rockets, enabling satellites to change orbits in space. In 1981, she joined NASA as a director of the solid rocket motor program in the Office of Space Flight (shuttle program) and later joined INMARSAT in London as a space segment engineer until retiring in 1991. She performed preliminary work on the Mars *Observer* spacecraft that was launched in 1992 and tracked launch vehicle performance on the *Scout*, *Delta*, *Atlas*, and *Titan* spacecraft. After retirement, she served as a consultant monitoring propulsion system activities for orbiting communication satellites.

Brill's many awards and honors include the RCA award for Astro-Electronics Engineering Excellence (1970), the Resnik Challenger Medal of the Society of Women Engineers (1993), and the SWE Achievement Award (1986). She is a fellow of the American Institute of Aeronautics and Astronautics and of the Society of Women Engineers, is a member of the British Interplanetary Society and the International Astronautical Union, and was elected to the National Academy of Engineering in 1987 and inducted into the Women in Technology International (WITI) Hall of Fame in 1999.

Briscoe, Anne M.

b. 1918

Biochemist

Education: B.A., Adelphi College, 1942; A.M., Vassar College, 1945; Ph.D., biochemistry, Yale University, 1949

Professional Experience: assistant chemist, University of Maine, 1942–1943; Vassar College, 1943–1945; physiological chemist, Yale, 1946–1947; fellow, University of Pennsylvania, 1949–1950; associate biochemist, medical college, Cornell University, 1950–1954, assistant professor, 1954–1955; research associate, school of medicine, University of Pennsylvania, 1956; associate biochemist, Columbia University, 1956–1972; assistant professor of medicine, College of Physicians and Surgeons, Columbia, 1972–1988

Anne Briscoe is a distinguished medical researcher and faculty member in biochemistry, with a primary emphasis on the metabolism of calcium and magnesium in humans. She has held positions with numerous prestigious employers, including the medical college of Cornell University, the University of Pennsylvania School of Medicine, and the College of Physicians and Surgeons of Columbia University. She has been active as a consultant for the Veterans Administration Hospital, Castle Point, New York. While her primary focus was on research, she has lectured in the School of General Studies of Columbia University, the School of Nursing at Harlem Hospital Center, and Antioch College's Physician's Assistant Program at Harlem Hospital Center.

Besides her research, Briscoe has been exceptionally active as an advocate for women in the sciences. She was one of the founding members of the Association for Women in Science (AWIS) in 1971 and subsequently served as president (1974–1976), chair of the AWIS Affirmative Action Committee, and co-chair of the Committee on Equity. She has published on women, feminism, and science, including co-editing (with Sheila Pfafflin) a book, *Expanding the Role of Women in the Sciences* (a publication of the New York Academy of Sciences, 1979). Her article, "Diary of a Mad Feminist Chemist," published in the *International Journal of Women's Studies* (1981), is an account of her years as a woman scientist at Cornell and Columbia. Commenting on her role as both as scientist and a part of the feminist movement, she has said, "Opportunities are greater for women than when I received a Ph.D. in 1949, and I only regret that I was born too soon."

Briscoe was elected a fellow of the American Institute of Chemists and a fellow of the New York Academy of Sciences, and served on the New York City Commission on the Status of Women. In 1997, she received the prestigious Wilbur L.

Cross Medal of the Yale Graduate School of Arts and Sciences. She also has been a member of the American Chemical Society and the American Society for Clinical Nutrition.

Britton, Elizabeth Knight

1858 1934

Botanist, Bryologist

Education: Hunter College, 1875

Professional Experience: critic teacher, Hunter College, 1875–1882, tutor, natural science, 1882–1885; curator of mosses, Torrey Botanical Club, 1884–1885, editor, *Bulletin of the Torrey Botanical Club*, 1886–1888; unofficial curator of mosses, Columbia College Herbarium, New York Botanical Garden, 1899–1912, honorary curator, 1912–1934

Elizabeth Knight Britton was an early botanist and one of the founders of the New York Botanical Garden. She became a well-regarded amateur botanist with a special interest in bryology, or the study of mosses. She built a collection of mosses and ferns from expeditions in North America and the Caribbean. She was raised and educated in New York and on a family-owned sugar plantation in Cuba. Always interested in science, she graduated from Hunter College in 1875 and taught there for 10 years until her marriage in 1885 to geologist Nathaniel Britton. In collaboration with her husband, who also taught botany, and working through his affiliation as professor at Columbia College, she built a significant moss collection at Columbia. The Brittons did not have children and often traveled together on botanical collecting expeditions. After visiting the Royal Botanic Gardens in England, the couple led the campaign to increase public botanical awareness and knowledge through the creation of the New York Botanical Garden, a 250-acre garden established in the Bronx in 1891 with Nathaniel Britton as its first director.

Elizabeth Britton's moss collection was eventually moved from Columbia to the Botanical Garden, where she was a full-time volunteer and became the honorary curator of mosses in 1912. Even though she did not hold an advanced degree, and did not draw a salary from either the Botanical Garden or from Columbia, she was regarded as an eminent botanical scientist of her day and even mentored graduate students in botany at Columbia.

Britton belonged to or helped create every significant botanical club in the late nineteenth and early twentieth centuries. She was an early member of the Torrey

Botanical Club who edited the club's *Bulletin* in the 1880s, and one of the founding (and only female) members of the Botanical Society of America in 1893. She co-founded the Sullivant Moss Society in 1898 (later the American Bryological Society), serving as president from 1916 to 1919 and also editing that group's journal, *Bryologist*. She also co-founded the Wild Flower Preservation Society of America in 1902, serving as secretary and treasurer for many years. She helped identify and preserve many species of wildflowers in the United States and authored or co-authored more than 300 scientific papers and articles on mosses, ferns, and wildflowers. There are numerous plant species and one moss genus, *Bryobrittonia*, named in her honor.

Further Resources

New York Botanical Garden. "Elizabeth Gertrude Knight Britton Records." http://sciweb.nybg.org/science2/libr/finding_guide/egbweb.asp.

Brody, Jane Ellen

b. 1941

Science Writer, Nutritionist

Education: B.S., biochemistry, New York State College of Agriculture and Life Sciences at Cornell University, 1962; M.S., journalism, University of Wisconsin, Madison, 1963

Professional Experience: reporter, *Minneapolis Tribune*, 1963–1965; science writer, *New York Times*, 1965–1976, health columnist, 1976–; independent author and lecturer, health and nutrition, 1979–

Jane Brody is the author of numerous articles and books on health and nutrition written for the general public. She combined an undergraduate degree in biochemistry with training as a journalist and science writer. She developed a special interest in nutrition and disease at an early age, for she lost both her mother and her grandmother to cancer while she was in her teens. She enrolled in the biochemistry curriculum at the New York State College of Agriculture at Cornell University and planned to become a research scientist. When she spent a summer in a research laboratory under a National Science Foundation fellowship at the New York State Agricultural Experiment Station at Geneva, New York, however, she decided laboratory research did not appeal to her as a career. In her senior year, after joining the staff of the *Cornell Countryman*, a school magazine dealing with scientific

and agricultural research, she enrolled in a few journalism courses as electives. She received a science writing fellowship for a one-year graduate program in journalism at the University of Wisconsin, Madison, where she received a master's degree in 1963.

Brody obtained a position as a general reporter for the *Minneapolis Tribune* and worked there for two years before securing a job as a full-time science writer, specializing in medicine and biology, at the *New York Times*. She brings a wealth of information to her columns, spending hours researching her subject and consulting experts in the field in order to present all sides of controversial subjects. In 1976, she began writing her "Personal Health" column for the *Times*. She urges her readers to adopt a healthy diet that features a high intake of complex carbohydrates, a moderate intake of proteins, and a reduction in the consumption of fat, sugar, and salt. She also advises some exercise daily rather than being a "weekend athlete." She warns against making a radical change in lifestyle. Her philosophy is one of moderation, a concept foreign to many Americans. She warns people that a healthy lifestyle does not mean one may eat a low-calorie salad and then "reward" oneself with a dessert rich in calories and fats. She speaks from her own experience. Although she is only five feet tall, in graduate school she weighed 140 pounds. She lost 40 pounds over a period of two years.

Her first book to gain national attention was *Jane Brody's Nutrition Book* (1981), in which she expanded the information she had been giving in her columns. The companion volume, *Jane Brody's Good Food Book* (1985), was a bestselling collection of her health-conscious recipes. She has also published collections of recipes for children and seafood recipes, and has published books on topics such as allergies and cancer, all of which promote healing primarily through a healthful diet. Her book *Jane Brody's Guide to the Great Beyond* (2009) deals with preparing medically and emotionally for end-of-life issues. She has been a television personality, including 10 episodes of her own show, *Good Health from Jane Brody's Kitchen*, which ran on PBS in the mid-1980s.

Brody has received honorary doctorates from Princeton University (1987) and Hamline University (1993). She is also the recipient of honors and awards from the American Heart Association (1971), a science writers' award from the American Dental Association (1978), and a lifetime award from the American Health Foundation (1978).

Further Resources

Jane Brody. <http://www.janebrody.net/>.

"Jane E. Brody: Recent and Archived News Articles by Jane E. Brody." http://topics.nytimes.com/topics/reference/timestopics/people/b/jane_e_brody/index.html.

Brooks, Carolyn (Branch)

b. 1946

Microbiologist

Education: B.S., Tuskegee University, 1968, M.S., 1971; Ph.D., Ohio State University, 1977

Professional Experience: science teacher, Union Springs, Alabama, 1968–1969; science teacher, Tuskegee, Alabama, 1971–1972; technician, Veteran’s Hospital, Tuskegee, Alabama, 1972–1973; teaching assistant, Ohio State University, 1975–1977; researcher and program director, community health studies, Kentucky State University, 1977–1981; professor, University of Maryland, Eastern Shore, 1981–

Concurrent Positions: dean and director, School of Agricultural and Natural Sciences, University of Maryland, Eastern Shore

Carolyn Brooks is a microbiologist who researches legumes in efforts to increase the nutritional value of such crops in developing countries. Legumes such as soybeans, peas, and beans enrich the soil and require little or no fertilizer, and Brooks has visited several West African countries to study a legume called the groundnut in order to help researchers in those countries increase the food value of that plant. Another area of her research is the creation of crop plant species that have built-in resistance to insects and other predators.

Brooks was born in Richmond, Virginia, and attended public school before full integration took place. Fortunately, she had teachers who realized that the changing social climate would bring more opportunities for educated African Americans, and they encouraged her to do well and to attend special summer sessions for science students. Brooks ultimately received offers of scholarships from six different colleges. She chose Tuskegee Institute, which had a strong science program, for both her undergraduate and master’s degrees before enrolling at Ohio State for her doctorate. She gave birth to three children while pursuing her education. Her first position after graduation was at Kentucky State University in a community health studies program that combined the resources of the university and statewide social services to improve the lives of rural residents. In her work on nutritional needs of the elderly, she found that the subjects’ hair indicated the amount of mineral intake in their diets, which meant that certain medical problems caused by improper diet could be diagnosed.

In 1981, she moved to the University of Maryland, Eastern Shore, where she is committed to both research and teaching and mentoring students and has served as Dean of the School of Agricultural and Natural Sciences. In 1988, she was

recognized for her teaching at the first annual White House Initiative on Historically Black Colleges and Universities, and in 1990, she received an Outstanding Educator Award from the Maryland Association of Higher Education.

Brooks, Matilda Moldenhauer

b. 1890

Physiologist

Education: A.B., University of Pittsburgh, 1912, M.S., 1913; Ph.D., biology, Radcliffe College, Harvard, 1920

Professional Experience: bacteriologist, research institute, National Dental Association, 1917–1920; assistant biologist, U.S. Public Health Service, 1920–1924, associate biologist, 1924–1927; research associate in physiology, University of California, Berkeley, 1927–, lecturer, zoology, 1934, 1936

Matilda Brooks was recognized for developing an antidote or treatment for cyanide and carbon dioxide poisoning. She accomplished this in 1932 while working as an unpaid research assistant at the University of California, Berkeley. After spending about six years with the U.S. Public Health Service, she and her husband, zoologist Sumner Cushing Brooks, moved to Berkeley, where she held a position as a research associate in physiology. Her husband held a faculty appointment at Berkeley (which, due to anti-nepotism rules, meant she could not be employed there) and, although she periodically substituted for her husband as a zoology lecturer, she was one of the few early women scientists without a regular teaching appointment who was therefore able to devote her entire career to research. Her work was supported by numerous distinguished grants, such as the Bache grant of the National Academy of Science, the Naples research grant of the National Research Council, the Permanent Science Foundation grant, and the American Philosophical Society grant. She took early courses at, and was a member of, the Marine Biological Laboratory at Woods Hole, Massachusetts, an honor that few women had enjoyed at that time. She and her husband regularly spent summers at Woods Hole conducting research. The Brooks not only researched together as a team, but jointly published articles and a book on *The Permeability of Living Cells* (1941). The couple also frequently lectured together, including an international lecture tour that took them to several South American countries in 1944.

Brooks was a member of several professional societies, including the American Physiological Society, Society of General Physiologists, and Cooper Ornithological Society. Although her long-term research had involved cell respiration and oxidation, her later research interests included the effects of solar light and ultraviolet light on sugar production and the four basic acids.

Further Resources

“Sumner Cushing Brooks: Zoölogy: Berkeley (1888–1948).” <http://content.cdlib.org/xtf/view?docId=hb9p300969&doc.view=content&chunk.id=div00002&toc.depth=1&brand=calisphere&anchor.id=0>.

Broome, Claire Veronica

b. 1949

Epidemiologist, Physician

Education: B.A., Harvard University, 1970; M.D., Harvard Medical School, 1975; diplomate, American Board of Internal Medicine, 1981

Professional Experience: deputy chief in pathogens, Bacterial Disease Division, Centers for Disease Control and Prevention, 1979–1980, chief, Bacterial Special Pathogens, National Center for Injury Prevention and Control (NCID), 1981–1990, acting director, 1991–1993, deputy director, 1994–1999, senior advisor, Integrated Health Information Systems, 2000–2006

Concurrent Positions: clinical assistant, School of Medicine, Emory University; adjunct professor, Department of Global Health, Rollins School of Public Health, Emory University

Claire Broome has performed significant research on bacterial disease epidemiology, including the public health aspects of pneumonia, meningitis, toxic shock syndrome, and Legionnaires’ disease. Born in England, she immigrated to the United States with her family in 1951. After completing her education, she joined the Centers for Disease Control and Prevention in 1979 and has remained there ever since. One of her significant achievements is her novel approach to estimating the effectiveness of a pneumococcal vaccine by comparing the distribution of serotypes (organisms distinguished by different surface antigens) in vaccinated and unvaccinated persons who have had the disease. Her method has proved essential in defining the appropriate use of the vaccine in the United States.

Another area of study has been the incidence of cerebrospinal meningitis epidemics. Meningitis is comparatively rare in the United States and other

industrialized countries (the last epidemic in the United States was in the 1940s), but the disease still reaches epidemic levels in underdeveloped countries. In an article published in *Scientific American* in November 1994, Broome reported that people living in central Africa are uniquely susceptible to repeated outbreaks of meningitis. The cycles of epidemics may correspond to environmental changes with heat and humidity, unusual patterns of immunity, or association with still other infectious diseases. The bacterium causing meningococcal meningitis is called *Neisseria meningitidis*, or “meningococcus.” It is a very common organism that many people carry without being infected.

Broome has served as an advisor for numerous national and international organizations, including the World Health Organization, Global Alliance for Vaccines and Immunization, Bill and Melinda Gates Foundation, USAID, U.S. Food and Drug Administration, and National Institutes of Health. She was elected to the Institute of Medicine (1996) and is a fellow of the Infectious Diseases Society of America and a member of the American Epidemiology Society, American College of Physicians, American Society for Microbiology, and American College of Epidemiology.

Brothers, Joyce Diane (Bauer)

b. 1929

Psychologist

Education: B.S., psychology, Cornell University, 1947; M.A., Columbia University, 1950, Ph.D., psychology, 1953

Professional Experience: teaching fellow, Hunter College, 1948–1950, instructor, 1950–1952, research fellow, 1952–1953; independent psychologist and writer, 1952–; television and radio personality, 1958–; columnist, *Good Housekeeping*, 1963–

Joyce Diane Brothers is a psychologist who has been a popular writer, as well as television and radio personality, and who pioneered the idea of phone-in advice on emotional and relationship issues. She first conducted her own local New York radio show in 1958, and was subsequently offered an afternoon talk show on NBC television. She became an instant celebrity through *The Dr. Joyce Brothers Show* and other syndicated programs that aired over the next two decades. She took live phone calls and responded to letters from viewers, pioneering the idea of short-term counseling and advice on oftentimes controversial issues related to sex, marriage, and parenting. She went on to write a syndicated advice column that ran in



Psychologist Joyce Brothers hosted popular radio and television advice programs. (AP/Wide World Photos)

more than 300 newspapers and has written a monthly column family life in *Good Housekeeping* magazine for more than 40 years. She has also written numerous books and made guest appearances playing herself, a well-recognizable and honest psychological expert, in television comedies, dramas, talk shows, and feature films.

Brothers's television career began on a somewhat unusual path—as a game show contestant. After receiving her doctorate from Columbia University in 1953, Brothers put her teaching and counseling career on hold to stay home with her young daughter. Her husband was still in medical school at the time and, hoping to win some extra money, Brothers studied for an appearance on a television quiz show, *The \$64,000 Question*, in 1955. She won the top prize and went on to the next

level in *The \$64,000 Challenge* in 1957, winning again. In addition to the much-needed money, Brothers gained the attention of broadcast executives as a personable, energetic, and intelligent contestant, and was offered other television appearances, including an early stint as a co-host of a sports show. Her radio show soon followed, and then a national television show. Critics within the psychiatric profession charged that she could not provide real therapy or treat mental illness in the radio and television formats, but Brothers countered that she provided practical solutions to common problems and, when necessary, advised callers to seek additional help from mental-health professionals.

Many of Brothers's books have been bestsellers, and her works have been translated into more than 20 languages. Her books include: *The Brothers System for Liberated Love and Marriage* (1975), *How to Get Whatever You Want Out of Life* (1978), *What Women Should Know about Men* (1982), *What Every Woman Ought to Know about Love and Marriage* (1988), *The Successful Woman: How You Can Have a Career, a Husband, and a Family—And Not Feel Guilty about It* (1989), *Widowed* (1992, published after the death of her husband of almost 40 years), *Positive Plus: The Practical Plan to Liking Yourself Better* (1994), *Dr. Brothers' Guide to Your Emotions* (1996), and *Middle Childhood: Practical Tips to Develop*

Greater Peace and Cooperation for Parents of Children Ages 7–12 (1997). She has received honorary degrees, and her awards and honors include the Mennen Baby Foundation Award (1959), Newhouse Newspaper Award (1959), Woman of Achievement Award from the Federation of Jewish Women's Organizations (1964), Merit Award from Bar-Ilan University (1968), Parkinson Disease Foundation Award (1971), and numerous other acknowledgements.

Brown, Barbara B.

1917 1999

Neurophysiologist, Pharmacologist

Education: B.A., Ohio State University, 1938; Ph.D., pharmacology, University of Cincinnati College of Medicine, 1950

Professional Experience: head, Division of Pharmacology, William S. Merrell Company, 1953–1957; research neuropharmacologist, Riker Labs, Inc., 1957–1962; consulting neurophysiologist, Veterans Administration Hospital, Sepulveda, California, 1963–1965; associate professor, pharmacology, University of California, Irvine, 1965–1973; chief, experimental physiology, Veterans Administration Hospital, Sepulveda, California, 1967–

Concurrent Positions: pharmacologist, Center for Health Science, University of California, Los Angeles (UCLA), 1957–1962; lecturer, psychiatry, UCLA Medical School, 1973

Barbara Brown helped create the science of biofeedback, a method of learning to control one's bodily functions by monitoring one's own brain waves, blood pressure, degree of muscle tension, and so forth. In the 1970s, she found that the brain emits at least four distinct kinds of waves, depending on its activity at the time. These are delta, the sleep pattern; theta, linked to creativity; beta, connected with mental concentration; and alpha, reflecting a relaxed state. The brain's constant electrical activity produces wave patterns, and these patterns can be measured and recorded using an electroencephalograph (EEG) attached to the scalp. Brown hypothesized that if people could connect physical sensations with each emission, they could perhaps learn to achieve the various states at will.

Not only did she discover biofeedback, Brown made innovative applications of its findings to human health. She also invented two tools to make alpha waves more vivid and memorable to patients and research subjects—the Alpha train and the Alpha wave racetrack. The Alpha train records the signals that reveal brain or body activity by starting when the alpha waves appear in a subject and stopping

when they disappear. The Alpha wave racetrack consisted of a racecar set operated by brain waves. Two people can be wired up at once and race their cars against each other, competing for alpha wave control.

After receiving her doctorate, Brown was employed as a pharmacologist with two corporations, William S. Merrell Company and Riker Labs, Inc. She then was appointed an associate professor of pharmacology at the University of California, Irvine for several years before securing an overlapping position as the chief physiologist at the Veterans Administration Hospital in Sepulveda, California. In addition to numerous papers, she published three books on biofeedback: *New Mind, New Body: Bio-Feedback*, *New Directions for the Mind* (1974), *Stress and the Art of Bio-feedback* (1977), and *Supermind, the Ultimate Energy* (1980). She was a founding member and first president (1969–1970) of the Biofeedback Research Society.

Brown, Rachel Fuller

1898 1980

Biochemist

Education: A.B., Mount Holyoke College, 1920; M.S., University of Chicago, 1921, Ph.D., chemistry, 1933

Professional Experience: teacher, private school, 1921–1924; assistant chemist, New York State Department of Health, 1926–1929, assistant biochemist, 1929–1936, senior biochemist, 1936–1951, associate biochemist, 1951–1964, research scientist, 1964–

Rachel Brown was responsible (along with her colleague **Elizabeth Hazen**) for one of the most important medical discoveries of the century: the development of the antibiotic fungicide, nystatin. Brown spent her entire career at the division of laboratories and research of the New York State Department of Health, where she worked with Hazen, a microbiologist, isolating antibiotics from soil organisms and testing their antifungal properties on mice. The two women produced two different fungicides, but announced the most successful, nystatin (named for their lab in New York State), in the fall of 1950. In the 1920s and 1930s, doctors began regularly prescribing powerful new antibiotics, but many patients developed severe side effects, including yeast and fungus growth. Nystatin, however, killed the harmful fungus without attacking common or helpful bacteria. Nystatin (under the brand name Mycostatin) has been used to treat yeast and fungal infections in humans, as well as to combat mold in animal feed and even in water-damaged paper products and artwork. The patent on the drug earned millions in royalties,

which Brown and Hazen used to form a foundation for scholarships and research in the natural sciences. A portion was designated to provide advanced training for the staff at the state laboratory where they worked. Later, the two women discovered two other new antibiotics, phalamycin and capacidin.

Brown originally intended to study history, but became interested in chemistry while attending Mount Holyoke College, where she was inspired by chemistry professor **Emma Perry Carr**. Brown went on to the University of Chicago for graduate work. She received her master's in 1921 but, for some reason, approval of her doctoral thesis and scheduling of her oral exams was initially delayed. Needing employment, she moved to Albany, New York, for a position with the State Department of Health without completing the degree. After proving herself and achieving some recognition as a scientist in that position, her professor at Chicago finally approved the thesis and she received her Ph.D. in 1933. Before her work leading to the development of nystatin, Brown researched bacteria responsible for pneumonia and helped develop a pneumonia vaccine.

Brown and Hazen were jointly awarded the Squibb Award in Chemotherapy (1955), the Distinguished Service Award of the New York State Department of Health (1968), and the Benham Award of the Medical Mycological Society of the Americas (1972). They were the first women awarded the Chemical Pioneer Award from the American Institute of Chemists (1975). In an interview toward the end of her life, Brown was quoted as saying that she hoped for "equal opportunities and accomplishments for all scientists regardless of sex." In 1981, a year after Brown's death, a joint biography of Brown and Hazen was published, *The Fungus Fighters: Two Women Scientists and Their Discovery*. In 1994, Brown was inducted into the National Inventors Hall of Fame, one of only a handful of women.

Further Resources

Baldwin, Richard S. 1981. *The Fungus Fighters: Two Women Scientists and Their Discovery*. Ithaca, NY: Cornell University Press.

Brugge, Joan S.

Cell Biologist, Cancer Researcher

Education: B.A., biology, 1971 Northwestern University, 1971; Ph.D., virology, Baylor College of Medicine, Texas, 1975

Professional Experience: postdoctoral fellow, University of Colorado Medical Center, 1975–1979; assistant professor, microbiology, State University of New York



Cell biologist and cancer researcher, Joan Brugge. (Courtesy of Harvard University)

at Stony Brook, 1979–1984, associate professor, 1984–1987, professor, 1988; investigator, Howard Hughes Medical Institute, and professor, microbiology, University of Pennsylvania, 1989–1992; scientific director, and senior vice president, Research and Biology, ARIAD Pharmaceuticals, Inc., 1992–1996, senior vice president, Exploratory Research, 1996–1997; professor, cell biology, Harvard Medical School, 1997–, acting chair, Department of Cell Biology, 2003, chair, 2004–

Joan Brugge is a cell biologist whose research focuses on the growth of cells, tissues, and tumors related to understanding breast cancer. After receiving her doctorate in virology from Baylor College of Medicine in 1975, Brugge held postdoctoral fellowships from the National Institutes of Health and the American Cancer Society to study at the University of Colorado Medical Center, where she isolated proteins in viral and cellular oncogenes and investigated normal cellular growth as well as tumor formations. She went on to teach microbiology and cell biology at State University of New York and at the University of Pennsylvania, but she left academia in 1992 to found ARIAD Pharmaceuticals, a drug development company researching new treatments for cancer and other diseases caused by cellular malformation, such as cystic fibrosis, asthma, and some allergies. She returned to teaching as professor of cell biology at Harvard Medical School in 1997 and became chair of that department in 2004.

Brugge has been an invited lecturer at numerous universities, conferences, and organizations, and has served as an advisor, consultant, or board member for pharmaceutical companies and research institutes, including the Howard Hughes Medical Institute, Massachusetts General Hospital Cancer Center, Massachusetts Institute of Technology Cancer Center, National Cancer Institute, Fox Chase Cancer Center, Van Andel Cancer Institute, and advisory committees and review panels for the National Institutes of Health and National Academies of Science. In 2009, she received a grant through the Breast Cancer Research Foundation for her continued work on cellular formation, migration, and abnormalities resulting in tumors.

Brugge was elected to both the National Academy of Science and the Institute of Medicine in 2001, and is a fellow of the American Academy of Arts and Sciences. She has received numerous awards and honors, including a National Cancer Institute Merit Award, American Cancer Society Research Professorship (2001), Arthur and Rochelle Belfer Foundation Award (2001), Senior Career Recognition Award from the American Society of Cell Biology (2001), Distinguished Alumnus Award from the Baylor College of Medicine (2003), National Cancer Institute Rosalind Franklin Award (2005), and Charlotte Friend Award of the American Association for Cancer Research (2005).

Further Resources

Harvard Medical School. Faculty website. <http://brugge.med.harvard.edu/>.

Buck, Linda B.

b. 1947

Biologist

Education: B.S., psychology and microbiology, University of Washington, Seattle, 1975; Ph.D. immunology, University of Texas Southwestern Medical Center, 1980

Professional Experience: postdoctoral fellow, neurobiology and molecular biology, Columbia University, New York, 1980–1984; associate, Howard Hughes Medical Institute, 1984–1991; assistant professor, neurobiology, Harvard Medical School, 1991–1996; associate professor, 1996–2001, professor, 2001–2002; full member, Division of Basic Sciences, Fred Hutchinson Cancer Research Center, and affiliate professor, physiology and biophysics, University of Washington, Seattle, 2003–

Concurrent Positions: assistant investigator, Howard Hughes Medical Institute, 1994–1997, associate investigator, 1997–2000, full investigator, 2001–



Linda Buck was co-recipient of the 2004 Nobel Prize in Physiology or Medicine for her research on the sense of smell. (Fred Hutchinson Cancer Research Center/Roland Morgan)

Linda Buck is a biologist who studies the mammalian olfactory system, or sense of smell. She was the co-recipient (with colleague Richard Axel) of the Nobel Prize in Physiology or Medicine in 2004, one of only eight American women to win in that category to date. Buck has investigated how the nose detects an incredible variety of odors and pheromones and how the brain interprets and acts upon these messages. In the early 1990s, Buck and Axel identified and cloned 1,000 different genes for odorant receptors in the nose, and their research eventually revealed differences between different groups of these receptors for different types of tastes (pheromones, bitter, sweet). She has also researched how odors impact the release of hormones related to reproduction and sexual behaviors. Buck received her doctorate in immunology from the University of Texas Southwestern Medical Center in 1980 and began working with Richard Axel as a postdoctoral researcher at Columbia University. She went on to teach neurobiology at Harvard Medical School for 10 years and then returned to the University of Washington (where she had received her undergraduate degree) as affiliate professor of physiology

and biophysics. She has also held research investigator positions at the Fred Hutchinson Cancer Research Center and the Howard Hughes Medical Institutes.

Buck was elected to the National Academy of Science in 2003 and the Institutes of Medicine in 2006. She is a fellow of the American Association for the Advancement of Science and the American Academy of Arts and Sciences. She has been Director's Lecturer at the National Institutes of Health (1999) and Ulf von Euler Lecturer at Karolinska Institutet in Sweden (1999). Her numerous other awards and honors preceding her 2004 Nobel Prize included the Takasago Award for Research in Olfaction (1992), Unilever Science Award (1996), R. H. Wright Award in Olfactory Research (1996), Lewis S. Rosenstiel Award for Distinguished Work in Basic Medical Research (1997), Perl/UNC Neuroscience Prize (2003), and Gairdner Foundation International Award (2003).

Further Resources

Howard Hughes Medical Institute. "Linda B. Buck, Ph.D." http://www.hhmi.org/research/investigators/buck_bio.html.

University of Washington. Faculty website. http://depts.washington.edu/pbiopage/people_fac_page.php?fac_ID=5.

Buikstra, Jane Ellen

b. 1945

Anthropologist, Archaeologist

Education: B.A., DePauw University, 1967; M.A., University of Chicago, 1969, Ph.D., anthropology, 1972

Professional Experience: instructor, Northwestern University, 1970–1972, assistant to associate professor, 1972–1984, professor, 1982–1986; professor, University of Chicago, 1986–1995; professor, University of New Mexico, 1995–2005; professor, Bioarchaeology and Director, Center for Bioarchaeological Research, Arizona State University, 2005–

Concurrent Positions: associate editor, *American Journal of Physical Anthropology*, 1978–1981; research associate, Field Museum of Natural History, 1981–; research associate, Museum of the American Indian, 1983–1986; resident scholar, School of American Research, 1984–1985; adjunct professor of anthropology, Washington University, 1986–; research associate, University of Florida, 1991–1997; research associate, University of Chicago, 1995–present; research associate



Anthropologist and archaeologist, Jane Buikstra. (Courtesy of the University of Arizona)

in anthropology, Field Museum of Natural History, 2003–2008; research associate, National Museum of Natural History, 2005–2009

Jane Buikstra is renowned for her research on prehistoric skeletal populations of the Americas, which emphasizes microevolutionary change and biological response to environmental stress. She is considered one of the founders of bioarchaeology, or the application of biological anthropological methods such as studying vital rates, population distribution, genetics, disease, and population density to the archaeological records of extinct human groups. This is a composite field involving forensic anthropology, physical anthropology, archaeology, and demography. Buikstra has conducted research at mounds and other historical sites throughout North America, South

America, and various Mediterranean countries, and has contributed archaeological evidence to studies of the spread of populations and of human diseases.

Under the 1990 Native American Graves Protection and Repatriation Act (NAGPRA), artifacts or remains that are encountered in construction projects or archaeological digs must be examined by trained archaeologists before a decision can be made regarding their disposal or other claims, and efforts must be made to return such items to descendants. Buikstra's work focuses on the scientific and ethical issues involved in such work. Among her numerous articles and publications, she is co-editor or co-author of the following books: *Human Identification: Case Studies in Forensic Anthropology* (1984), *Standards for Data Collection from Human Skeletal Remains* (1994), *The Bioarchaeology of Tuberculosis: A Global View on a Reemerging Disease* (2003), *Interacting with the Dead: Perspectives on Mortuary Archaeology for the New Millennium* (2005), and *Bioarchaeology: The Contextual Study of Human Remains* (2006).

Her research has been supported by grants from the National Science Foundation, National Geographic Society, and Wenner-Gren Foundation. Buikstra was elected to membership in the National Academy of Sciences in 1987. She has been

a fellow of the American Academy of Forensic Sciences, the American Association for the Advancement of Science, and the Smithsonian Institution, and a member of the American Anthropological Association, American Association for Physical Anthropologists (president, 1985–1987), American Board of Forensic Anthropology, and Society of Professional Archaeologists.

Further Resources

Arizona State University. Faculty website. <http://www.asu.edu/clas/shesc/faculty/buikstraj.htm?Name>.

Bunce, Elizabeth Thompson

1915–2003

Geophysicist

Education: A.B., Smith College, 1937, M.A., physics, 1949

Professional Experience: instructor, physics, Smith College, 1949–1951; research assistant, Woods Hole Oceanographic Institution, 1951–1964, associate scientist, physics and geophysics, 1964–1975, senior scientist, 1975–1980, emeritus scientist

Elizabeth Bunce was the first American woman to become chief scientist of a major oceanographic expedition at Woods Hole Oceanographic Institution. She was a geophysicist whose research interests included marine seismology and underwater acoustics through study of the seafloor. As chief scientist, she led numerous expeditions out to sea, including cruises to the Indian Ocean in 1964 and 1971 surveying sites for scientific deep-sea drilling. In 1965, she was the first woman to dive in “Alvin,” a deep-sea submersible vehicle. When she began her career, few women were engaged in oceanographic exploration at all, but Bunce broke those barriers by progressing from research assistant to senior scientist at Woods Hole and achieving many “firsts” as a woman. In addition to her research, she was the first woman to serve as a department chair at Woods Hole, in the department of Geology and Geophysics. In the early 1960s, she appeared on the television game show, *To Tell the Truth*, where contestants failed to identify her as the oceanographer on the panel. In 1995, she was honored at a special “Woman Pioneers in Oceanography” conference held at Woods Hole.

Bunce loved sports and studied physical education in college. She worked as a physical education teacher in New Jersey for four years before a summer visit to

Woods Hole in 1944 led to a job with the underwater explosives research group. Bunce's interest in science was piqued and she returned to Smith College to pursue graduate work in and then teach physics while working summers at Woods Hole, where she joined the staff full-time in 1952 and spent the remainder of her long career. She authored or co-authored numerous papers on marine geophysics and was honored in 2003, the year of her death, with the naming of the "Bunce Fault" located in the deepest trench of the Atlantic Ocean.

Bunce received an honorary doctorate from Smith College in 1971. She was a fellow of the Geological Society of America, and a member of the Society of Exploration Geophysics, the American Geophysical Union, and the American Association of Petroleum Geologists.

Further Resources

Woods Hole Oceanographic Institution "In Memoriam: Elizabeth T. Bunce." <http://www.whoi.edu/page.do?pid=10934&tid=282&cid=730&ct=163>.

Bunting (Smith), Mary Ingraham

1910–1998

Microbiologist

Education: A.B., Vassar College, 1931; A.M., University of Wisconsin, 1932, Ph.D., agricultural bacteriology, 1934

Professional Experience: assistant agricultural bacteriologist and agricultural chemist, University of Wisconsin, 1933–1935; faculty, biology, Bennington College, 1935–1937; instructor, physiology and hygiene, Goucher College, 1937–1938; research fellow, Yale University, 1938–1941; fellow, Wellesley College, 1946–1947; research assistant, Yale University, 1948–1952, lecturer, microbiology, 1952–1955; dean, Douglass College of Rutgers University, 1955–1960; president, Radcliffe College, 1960–1972; assistant to president, Princeton University, 1972–1975

Concurrent Positions: commissioner, Atomic Energy Commission, 1964–1965; member, national science board of the National Science Foundation, 1965–1970

Mary Bunting (Smith) was a renowned scientist as well as an influential president of Radcliffe College who helped integrate women into Harvard University in the 1960s. She had received her graduate degrees in agricultural bacteriology at the University of Wisconsin, Madison, and went on to teach microbiology, genetics, and physiology at several schools, including Bennington College, Goucher College, Yale University, and Wellesley. Even as she raised four children and ran the family farm after her

husband's early death, she continued her bacteriology research part-time at Yale before accepting a position in 1955 as dean of Douglass College in New Jersey, the women's school at Rutgers University. Her interest and experience working with female students led to the position in 1960 as president of Radcliffe College in Cambridge, Massachusetts. Bunting continued her scientific studies with a one-year leave from Radcliffe to consult for the U.S. Atomic Energy Commission. She was at Radcliffe for more than a decade, then held an administrative position at Princeton University for three years before retiring in 1975.

Bunting was featured on the cover of *Time* magazine in November 1961 because of her effort to integrate women into Harvard and raise the expectations of women for their own educations. Radcliffe College had been founded in 1879 as the women's annex at Harvard University. In 1963, under Bunting's tenure, Radcliffe students were the first women to receive joint degrees from Harvard and women were admitted for the first time to Harvard graduate and business schools. She helped reorganize Radcliffe as a top-notch research center for women scholars (including inviting part-time and married researchers) with the founding of the Radcliffe Institute for Independent Study, later renamed the Bunting Institute.

Bunting was awarded the National Institute of Social Scientists Gold Medal in 1962, was elected to the National Science Board of the National Science Foundation, and received numerous honorary degrees. She was a member of the American Academy of Arts and Sciences and the American Society for Microbiology. She was known to many as "Polly" and is identified in some sources by her later name, Bunting-Smith.

Further Resources

Yaffe, Elaine. 2005. *Mary Ingraham Bunting: Her Two Lives*. Savannah, GA: Frederic C. Beil.



Microbiologist Mary Ingraham Bunting served as president of Radcliffe College in the 1960s and helped fully integrate women into Harvard University. (AP/Wide World Photos)

Harvard. Obituary. <http://www.news.harvard.edu/gazette/1998/01.29/MaryBunting-Smi.html>.

“Education: One Woman, Two Lives.” *Time*. (3 November 1961). <http://205.188.238.109/time/magazine/article/0,9171,897907-1,00.html>.

Burbidge, (Eleanor) Margaret

b. 1919

Astrophysicist, Astronomer

Education: B.Sc., University of London, 1939, Ph.D., astrophysics, 1943

Professional Experience: acting director, University of London Observatory, 1943–1951; research associate, astronomy, Yerkes Observatory, 1951–1953; research fellow, astrophysics, California Institute of Technology, 1955–1957; Shirley Farr fellow in astronomy, Yerkes Observatory, 1957–1959; associate professor, University of Chicago, 1959–1962; associate research professor, University of California, San Diego, 1962–1964, professor, 1964–1990, director, Center for Astrophysics and Space Science, 1979–1988, emeritus professor, 1990–

Concurrent Positions: director, Royal Greenwich Observatory, 1972–1973

Margaret Burbidge is considered one of the premier woman astrophysicists of the twentieth century. Burbidge and her husband, Geoffrey Burbidge, are both astronomers and divided their time between the United States and England for a number of years before becoming U.S. citizens in 1977. Margaret Burbidge was interested in science at an early age due to the influence of her father, a chemistry professor, and her mother, who had also studied chemistry. Early on, Burbidge became interested in the origin of chemical elements and the chemical composition of stars. Although some astronomers thought all elements had been created when the universe was born, the Burbidges were among those who believed that elements are constantly being made inside stars. In England, the couple worked with astronomer Fred Hoyle and nuclear physicist William Fowler to refine Hoyle’s theory that elements are created by fusion reactions. They called the theory “the B2HF theory,” based on the initials of the four participants. When the couple returned to the United States in 1955, Margaret had hoped to obtain a fellowship to work at Mt. Wilson Observatory, but only male applicants were accepted. Geoffrey received the fellowship, and Margaret shared his access to the observatory. In 1959, the couple received the Warner Prize of the American Astronomical Society for a paper on the B2HF theory; Margaret remains, to date, the only woman to have received this prize for young astronomers.

Geoffrey Burbidge was offered an associate professorship at the University of Chicago, which operates the Yerkes Observatory, but because of anti-nepotism rules, Margaret was first given only a research fellowship; later, she became an associate professor. When she was invited to be director of the Royal Greenwich Observatory, her husband was offered a position there as an astronomer. The two were offered positions at the University of California, San Diego in 1962, where Margaret was appointed professor of astronomy. In the 1970s, Margaret served on the Space Science Board, which advises the National Aeronautics and Space Administration (NASA) on programs in space. As director of the Center for Astrophysics and Space Science at San Diego, Burbidge was assigned to oversee the faint object spectrograph for the Hubble telescope, which was launched in 1990.

Burbidge was the first woman to serve as director of the Royal Greenwich Observatory in England (1972–1973) and the first woman president of the American Astronomical Society (1976–1978). She was elected to membership in the National Academy of Sciences in 1978. In addition to numerous papers and articles, the couple published one book, *Quasi-stellar Objects* (1967). She has received several honorary degrees and awards, including the Warner Prize (1959), the Bruce Medal of the Astronomical Society of the Pacific (1982), the National Medal of Science (1985), and the Albert Einstein World Award of Science Medal (1988). She was elected a fellow of the American Academy of Arts and Sciences and the American Association for the Advancement of Science (president, 1982). She is also a member of the American Astronomical Society, International Astronomical Union, American Philosophical Society, and New York Academy of Sciences. In 2001, Margaret Burbidge received the UCSD Founders Distinguished Senior Scholar Award, and in 2005, the Royal Astronomical Society of England jointly awarded the couple its highest honor, the Gold Medal, for their lifetime achievements as scientists. Some sources use her first name or initial, as in Eleanor Margaret Burbidge or E. Margaret Burbidge; some sources have been found to list her name in error as Burbridge.

Further Resources

Byers, Nina and Gary A. Williams. 2006. *Out of the Shadows: Contributions of Twentieth-Century Women to Physics*. New York: Cambridge University Press.

Butler, Margaret K.

b. 1924

Mathematician, Computer Scientist

Education: B.A., Indiana University, 1944

Professional Experience: statistician, U.S. Bureau of Labor Statistics, 1945–1946 and U.S. Air Force in Europe, 1946–1948; mathematician, Argonne National Laboratory, 1948–1949; statistician, U.S. Bureau of Labor Statistics, 1949–1951; mathematician, National Energy Software Center, Argonne National Laboratory, 1951–1980, director, 1960–1993, senior computer scientist, 1980–1993

Margaret Butler helped to develop one of the first digital computers for science as a staff mathematician at Argonne National Laboratory in the early 1950s. Butler had one of the earliest and one of the longest careers for a woman in computer sciences, and was involved at every stage of technological change for nearly 50 years. She participated in the evaluation and selection of the first commercial digital computer for scientific computation, and prepared and implemented programs for both the UNIVAC and the AVIDAC computers. In addition, she worked on the logical design of Argonne's GEORGE computer and designed computer programs to solve engineering problems and to aid in the design of nuclear reactors. She did important early work in software as a junior mathematician in the Naval Reactor Division at Argonne, where she performed some of the computation work underlying the *Nautilus* submarine prototype. As head of the applications programming section of the Applied Mathematics Division (AMD) at Argonne, she directed the development of the AMD Program Library and Argonne's first computer operating system. During the late 1960s and early 1970s, she researched computers for image processing and reactor physics computation. As a senior computer scientist in the 1980s, she conducted benchmark studies for evaluating laboratory computers. She researched computing technology forecasting, applying computers to scientific and engineering problems, and was involved in preparing standards for computers and information processing. She felt one of her most significant contributions was in creating and directing the National Energy Software Center (also called the Argonne Code Center), a clearinghouse for the worldwide exchange of computer programs for peaceful uses of nuclear energy and development of world standards for computer technology.

Butler was elected a fellow of the American Nuclear Society in 1972. She was a member of the Association for Computing Machinery, American Association for the Advancement of Science, Institute of Electrical and Electronics Engineers, Association of Women in Science, and Association for Women in Computing. In recent years, she has been active in compiling the history of women's contributions at Argonne.



Cady, Bertha Louise Chapman

1873 1956

Entomologist

Education: A.B., 1895, Stanford University, A.M., 1902, Ph.D., entomology, 1923

Professional Experience: high school teacher, 1900–1907; assistant in nature study, University of Chicago, 1907–1909; instructor, biology, California State Teachers College, Chico, 1918; lecturer, Stanford University, 1921–1923; naturalist, National Girl Scouts, 1924–1936

Concurrent Positions: lecturer and field secretary, Social Hygiene Association, 1914–1924; secretary, Coordinating Council on Nature, 1928–1930

Bertha Cady was trained as an entomologist, but her research and teaching interests included natural history and child and adolescent psychology. She made contributions to science education through her long-term association with the nature study movement. While teaching biology at the high school level, she was the director of nature study for the high schools in Oakland, California. She became an assistant in nature study in the school of education at the University of Chicago and later taught in the biology department at California State Teachers College. She received degrees from Stanford University and also took courses at the University of Chicago, University of California, and Columbia University. She earned her doctorate from Stanford in 1923, at the late age of 50.

Cady then obtained employment as a naturalist for the Girl Scouts, and during that time, she served as secretary of the Coordinating Council on Nature. Prior to this, she worked as lecturer and field secretary of the Social Hygiene Association. She published in journals of nursing and public health, and co-authored a book, *The Way Life Begins: An Introduction to Sex Education*, written with her husband, psychologist Vernon Mosher Cady, and published by the American Social Hygiene Association in 1917. This was a book for children that explained reproduction in the plant, animal, and human worlds. Also during this period, as a member of the National Tuberculosis Association, she served as the director of the department of nature study for several years and was president of the American Nature Study Society from 1926 to 1929. She published numerous pamphlets,

teacher's guides, and books on nature study, including *Animal Pets: A Study in Character and Nature Education* (1930) and *Nature Guides for Schools, Volunteer Organizations, Camps, and Clubs* (1930).

Caldicott, Helen Mary (Broinowski)

b. 1938

Pediatrician, Antinuclear activist, Environmentalist

Education: M.B. (Bachelor of Medicine) and B.S. (Bachelor of Surgery), Adelaide Medical School, South Australia, 1961

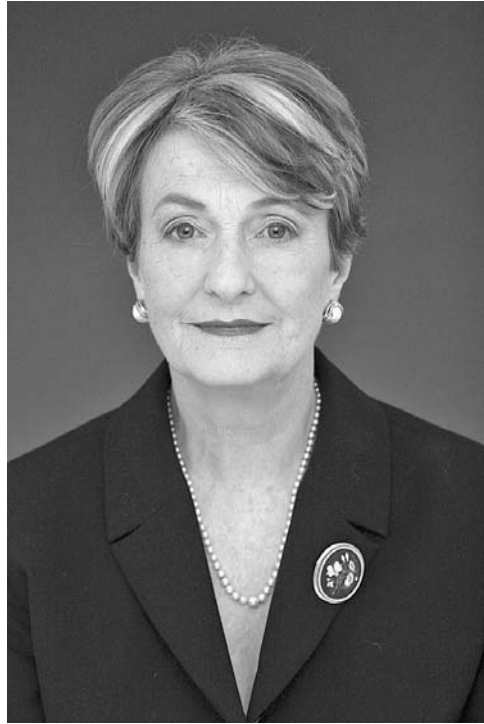
Professional Experience: intern, Royal Adelaide Hospital, South Australia, 1961; general medical practice, South Australia, 1963–1965; research fellow, nutrition, Children's Hospital Medical Center, Boston, 1967–1968; intern, Adelaide Children's Hospital, 1972, resident, 1973–1974, founder and head of cystic fibrosis clinic, 1975–1976; fellow in cystic fibrosis, Children's Hospital Medical Center, 1975–1976, assistant in medicine, 1977–1980; independent activist and writer, 1980–

Concurrent Positions: fellow, nutrition, Harvard University Medical School, 1966–1968, instructor, pediatrics, 1977–1980; president, Physicians for Social Responsibility, 1977–1986; founder and president, Physicians for Social Responsibility, 1978–1983, president emeritus; instructor, New School for Social Research, New York, 1995–1996; Laurie Chair in Women's Studies, Douglass College, Rutgers University, 2001

Helen Caldicott quit her position as a physician at the Children's Hospital Medical Center in Boston, Massachusetts, in 1980 to devote all of her time to her campaign against the use of nuclear energy, including an attempt to ban the mining of uranium in the western part of the United States. She was a six-year-old child living in Australia when the atomic bomb was dropped on several cities in Japan, and she first became concerned about nuclear energy when, as a teenager, she read Nevil Shute's book *On the Beach*, a chilling story set in Australia about a nuclear holocaust. She was a practicing physician in Australia when she received a fellowship for further study at Children's Hospital in Boston and her husband, also a physician, received a fellowship from Harvard. On her return to Australia for further training in pediatrics, she worked with children who had cystic fibrosis and became head of the cystic fibrosis unit in 1975.

She had a devastating experience in 1969 when she caught hepatitis from a patient by accidentally pricking her finger. She felt that her life had been saved

because she was meant to make a commitment to human survival. She became incensed that the French government, ignoring an international ban, was conducting atmospheric nuclear tests on islands in the Pacific, and that the fallout was drifting toward South Australia. She started gathering reports on the amount of radioactive matter in drinking water and cow's milk and sent the reports to medical groups, newspapers, news organizations, and other sources, and was interviewed on radio and television programs. She gained so much public support that, in 1973, the Australian and New Zealand governments took the French government before the International Court of Justice in The Hague in an effort to get the French to discontinue the tests. The French government complied with the court's ruling and stopped the tests.



Helen Caldicott, an advocate of nuclear disarmament, is one of the most well-known activists of the late 20th century. (Greg Barrett)

When Caldicott and her family returned to Boston in 1975, she tried to rally the American public to ban all military and peaceful uses of nuclear energy. She had little success with her campaign, until the failure at the nuclear power plant at Three Mile Island in Pennsylvania created more public concern about nuclear energy. In 1978, she revived the flailing organization Physicians for Social Responsibility (originally founded in 1962), and served as president until 1983. She also founded Medical Campaign Against Nuclear War, Women's Action for Nuclear Disarmament, Standing for Truth About Radiation, Women's Party for Survival, and the Nuclear Policy Research Institute. She produced several documentary films, including *If You Love This Planet*, which won an Academy Award for Best Documentary in 1982, and has published numerous books, including *Nuclear Madness: What You Can Do* (1970), *Missile Envy* (1986), *If You Love This Planet: A Plan to Heal the Earth* (1991; rev. ed., 2009), *The New Nuclear Danger* (2001), and *Nuclear Power Is Not the Answer* (2006). Her autobiography is *A Desperate Passion* (1996). She has received numerous honorary degrees and honors, and was nominated for a Nobel Peace Prize.

Further Resources

“Helen Caldicott, MD.” <http://www.helencaldicott.com/about.htm>.

Calloway, Doris (Howes)

1923–2001

Nutritionist

Education: B.S., Ohio State University, 1943; Ph.D., nutrition, University of Chicago, 1947; diplomate, American Board of Nutrition, 1951

Professional Experience: intern in dietetics, Johns Hopkins University Hospital, 1944; research dietitian, Department of Medicine, University of Illinois, 1945; consulting nutritionist, Medical Associates of Chicago, 1948–1951; nutritionist, QM [Quartermaster] Food and Container Institute, 1951–1958; head of metabolism laboratory, 1958–1959, chief of nutrition branch, 1959–1961; chair, Department of Food Science and Nutrition, Stanford Research Institute, 1961–1963; professor of nutrition, University of California, Berkeley, 1963–1991, provost and professor, 1981–1987, professor emeritus, 1991–2001

Concurrent Positions: associate editor, *Nutrition Reviews*, 1962–1968; editor and consultant, Food and Agriculture Organization, United Nations, 1971 and 1981

Doris Calloway was a renowned nutritionist with a wide range of experience working on areas related to food safety, food preservation, food energy, and human metabolism and digestion. Calloway was initially interested in studying medicine, but a lack of family funds and a scholarship led her to Ohio State University and a B.S. in nutrition and dietetics, and then to the University of Chicago for her doctorate in nutrition. She was employed for about 10 years by the QM Food and Container Institute, which was funded by the U.S. Army Quartermaster Corps. In the 1950s, the Army was concerned about the effect of nuclear radiation on soldiers' rations, and Calloway's research focused on trying to determine various foods' resistance to radiation. The Army acknowledged her with a “Man of the Year” award in 1959, something Calloway found quite amusing. After the Korean War, government research turned to space travel and, now employed by the Stanford Research Institute, Calloway's research on food packaging led to the creation of freeze-dried orange juice and, ultimately, the product Tang as an astronaut staple. In 1963, she received an appointment as professor at the University of California, Berkeley, a school with an international reputation in nutrition, where she studied food protein requirements, specifically the role of nitrogen in the diets

of people of different ages, health, and levels of physical activity. She served as the head of a multimillion-dollar study on malnutrition in Kenya, Mexico, and Egypt, and also served as a consultant for the United Nations Food and Agriculture Organization. Her methods and findings influenced the way government and humanitarian agencies approach the problem of malnutrition and the special dietary needs of pregnant and lactating women in developing areas of the world.

Calloway served on numerous committees and panels ranging from United Nations groups to the National Institutes of Health and its National Institute of Aging and National Institute of Arthritis, Metabolic and Digestive Diseases. She was involved in work with the International Maize and Wheat Improvement Center, a renowned research facility located in Mexico City, and the National Research Council. She wrote *Nutrition and Health* (1981) and *Human Ecology in Space Flight* (1967), as well as editing 11 editions of the textbook *Nutrition and Physical Fitness* (1966–1984). She served on the editorial board of numerous professional journals.

Calloway was elected a fellow of the American Institute of Nutrition (president, 1982–1983), the International Union of Nutritional Science, the Institute of Medicine, and was a member of the Human Biology Council. She received an honorary doctorate from Tufts University in 1992. Her husband, Dr. Robert Nesheim, was also a food researcher and was employed at Quaker Oats.

Further Resources

King, Janet C. 2003. “Doris Howes Calloway (1923–2001).” American Society for Nutritional Sciences. *Journal of Nutrition*. 133:2113–2116. (July 2003). <http://jn.nutrition.org/cgi/content/full/133/7/2113>.

Cannon, Annie Jump

1863–1941

Astronomer

Education: B.S., Wellesley College, 1884, M.A., 1907; special student, Radcliffe College, 1895–1897

Professional Experience: astronomer, Harvard College Observatory, 1896–1940, curator of astronomical photographs, 1911–1938, William Cranch Bond Astronomer, Harvard University, 1938–1940

Annie Cannon was a distinguished astronomer and probably the best-known woman astronomer in the first half of the twentieth century. Her specialty was



Annie Jump Cannon catalogued the stars and was the most famous female astronomer of the first half of the 20th century. (Library of Congress)

the study of stellar spectra and, although she did not create the concept or invent the methodology for studying stellar spectra, she simplified and perfected the system. She was one of the pioneers in the photographic study of stellar variability, and she discovered 277 variable stars and 5 new stars. She produced such a huge volume of data that she was popularly called the “Census Taker of the Stars.” She published over 90 catalogs and papers, and her major publications were *The Henry Draper Catalogue* (1918–1924) and *The Henry Draper Extension* (1925–1949). No other astronomer or group of astronomers has yet matched the sheer bulk of her output in the field of spectral classification.

Cannon became interested in astronomy at Wellesley while studying under Sarah Whiting, but she spent several intervening years at home with her

parents before returning to Wellesley as a postgraduate student. She became an assistant at the Harvard College Observatory in 1896 at a time when several other women were employed as astronomers, such as Williamina Fleming, **Antonia Maury**, and **Henrietta Swan Leavitt**. Interestingly, both Cannon and Leavitt were at least partially deaf. Cannon went on to succeed Fleming as curator of the observatory’s astronomical photographs and in 1938 was appointed William Cranch Bond Astronomer at Harvard University, one of the first appointments of a woman at Harvard.

Cannon was awarded six honorary degrees as well as the Nova Medal of the American Association of Variable Star Observers (1922), the Draper Medal of the National Academy of Sciences (1931), and the Ellen Richards Prize of the Society to Aid Scientific Research by Women (1932). She was elected to membership in such honorary societies as the American Philosophical Society of Philadelphia and the American Academy of Arts and Sciences of Boston. In 1933, she established the Annie J. Cannon Prize of the American Astronomical Society to be awarded triennially to a woman who demonstrates distinguished service to astronomy. Cannon also supported women’s suffrage and was a member of the National Woman’s Party.

Carey, Susan E.

Psychologist

Education: B.A., Radcliffe College, 1964; Ph.D., Harvard University, 1971

Professional Experience: lecturer, psychology, Harvard University, 1971–1972; adjunct assistant professor, Rockefeller University, 1974–1975; assistant to associate professor, psychology, Massachusetts Institute of Technology (MIT), 1972–1984, professor, brain and cognitive sciences, 1984–1996; professor, psychology, New York University (NYU), 1996–2001; professor, psychology, Harvard University, 2001–, Henry A. Morss, Jr., and Elizabeth W. Morss Professor of Psychology, 2004–

Concurrent Positions: fellow, Radcliffe Institute, 1976–1978; Sloane Fellow, University of California, Berkeley, 1980–1981; fellow, Institute for Advanced Studies in the Behavioral Sciences, 1984–1985

Susan Carey is a psychologist and researcher of cognitive development who studies language and language development. Her research is unique in that it combines the concerns and questions of philosophy, linguistics, history of science, and the acquisition of culture with neuroscience and brain development. She has been a pioneer in the field of word meaning, language and numbers acquisition, and the recognition of human and nonhuman objects by infants under one year old. She has collaborated and co-authored papers with her colleague at Harvard's Laboratory for Developmental Studies, **Elizabeth Spelke**. In addition to her numerous papers, articles, and book chapters, Carey is co-editor of several books, and author of *Conceptual Change in Childhood* (1985) and *The Origin of Concepts* (2009), which examines how children acquire complicated and abstract concepts and terminology created by adults. Her work questions our understandings of innate versus acquired knowledge, explores the relationship between thought and language, and has implications for adult interactions with infants as well as early childhood education, especially in math and science.

Carey was elected to the National Academy of Sciences in 2002. She is a fellow of the American Academy of Arts and Sciences, British Academy, American Philosophical Society, and National Academy of Education, and was named a William James Fellow of the American Psychology Society (2002). She is also a member of the Society for Experimental Psychology, Society of Cognitive Neuroscience, International Society for Infant Studies, Society for Research in Child Development, Society for Philosophy and Psychology (president, 1983–1984), and Piaget Society. She was the recipient of a Cattell Fellowship (1995–1996), the Jean Nicod Prize, Paris (1998), and a Guggenheim Fellowship (1999–2000),

and her work has also been supported by grants from the National Institutes of Health and the National Science Foundation. She has served on the editorial boards of journals such as *Psychological Review*, *Psychological Science*, *Journal of Language Acquisition*, *Developmental Psychology*, and others.

Further Resources

Harvard University. Faculty website. <http://www.wjh.harvard.edu/~lds/index.html?carey.html>.

Carothers, (Estrella) Eleanor

1882 1957

Zoologist

Education: Nickerson Normal College, Kansas; B.A., University of Kansas, 1911, M.A., 1912; Ph.D., University of Pennsylvania, 1916

Professional Experience: assistant professor, zoology, University of Pennsylvania, 1913–1926, lecturer, 1926–1933; research associate, University of Iowa, 1935–1941

Concurrent Positions: member, Woods Hole Marine Biological Laboratory, 1920–1956

Eleanor Carothers specialized in insect genetics and made contributions to the study of the cytological, or cellular, basis of heredity. She primarily studied the insect order of “orthoptera,” which includes grasshoppers, crickets, locusts, and cockroaches. Having attended Normal College, she was probably a school teacher before receiving her undergraduate and master’s degrees from the University of Kansas. She went on to receive a Ph.D. from the University of Pennsylvania, where she was an assistant professor of zoology and one of the few female members of scientific expeditions to the Southern and Southwestern states in 1915 and 1919. Her most important work, *The Segregation and Recombination of Homologous Chromosomes as Found in Two Genera of Acrididae (Orthoptera)*, was published in 1917, and her research is still referred to in graduate courses today. She received major funding to research grasshopper cells through a grant from the Rockefeller Foundation Fund. For most of her career, she was an independent researcher affiliated with institutions such as the Marine Biological Laboratory at Woods Hole, Massachusetts, and in 1933, she began an affiliation at the University of Iowa as a research associate in zoology.

Carothers was one of only seven women cited as primary investigators by Thomas H. Morgan in *The Mechanism of Mendelian Heredity* (1915), and her findings on the effect of x-rays on cells were published in leading scientific journals, such as the *Journal of Morphology*, *Biological Bulletin*, and *Proceedings of the Entomological Society*. She was awarded the Ellen Richards Research Prize of the Naples Table Association in 1921. She was an elected member of the Academy of Natural Sciences of Philadelphia.

Carr, Emma Perry

1880 1972

Chemist

Education: Ohio State University, 1898–1899; Mount Holyoke College, 1901–1904; B.S., University of Chicago, 1905, Ph.D., physical chemistry, 1910; Queen's University, Belfast, 1919; University of Zurich, 1925, 1929–1930

Professional Experience: instructor, chemistry, Mount Holyoke College, 1905–1908, associate professor, 1910–1913, professor and chair, 1913–1946

Emma Carr developed an ambitious research program in chemistry at Mount Holyoke, making that institution one of the first American research centers to make use of ultraviolet spectrophotometry to determine the structure of complex organic molecules. She was affiliated with Mount Holyoke for 65 years, building a strong science program for women in the tradition of the school's founder, Mary Lyon, who was also a chemistry teacher. She and her students made fundamental contributions to the understanding of the causes of selective absorption of radiant energy. She received grants in the 1930s and 1940s from the National Science Foundation and the Rockefeller Foundation to investigate simple unsaturated hydrocarbons using ultraviolet spectrophotometry. She was a cooperating expert in charge of absorption spectra data for the International Critical Tables.

Carr received numerous grants and prizes during her career, and was chosen in 1937 as the first recipient of the Garvan Medal of the American Chemical Society. She was elected a fellow of the American Physical Society and also was a member of the American Chemical Society and the Optical Society of America. She received honorary degrees from Allegheny College in 1939, Russell Sage College in 1941, and Mount Holyoke College in 1952.

Carson, Rachel Louise

1907 1964

Biologist, Conservationist

Education: B.A., Pennsylvania College for Women, 1929; M.S., zoology, Johns Hopkins University, 1932

Professional Experience: zoology staff, University of Maryland, 1931–1936; biologist, Bureau of Fisheries, 1936–1949, editor-in-chief, 1949–1952; independent author

Rachel Carson was a prominent figure in the mid-twentieth-century conservation movement, and her name is often synonymous with the idea of *ecology*. Her 1962 book, *Silent Spring*, was one of the first efforts to point out the dangers of using insecticides, notably DDT, and is often credited with starting the modern environmental movement. The book stirred a national controversy, arousing public opinion and leading to legislative change. Carson's interest in natural history prompted her to major in science in college. She received a degree in zoology and taught science courses before beginning graduate studies at the Marine Biological Laboratory in



Rachel Carson, shown here giving testimony before Congress in 1963, was a noted biologist and ecology writer who helped launch the modern environmental movement. (Library of Congress)

Woods Hole, Massachusetts. In 1936, she accepted a position as an aquatic biologist with the Bureau of Fisheries, one of the first two women professionals to be hired by the bureau. She supplemented her income by writing magazine articles on natural history subjects in addition to writing numerous publications on conservation for the bureau. In 1940, when the Bureau of Fisheries merged with the Biological Survey to form the U.S. Fish and Wildlife Service, one of the stated purposes of the new department was conservation, and Carson became editor-in-chief of the bureau's publications. She produced 12 government pamphlets on "Conservation in Action," arguing for a national policy for conserving natural resources.

Carson had published three other books before *Silent Spring* made her famous: *Under the Sea Wind* (1941), *The Sea Around Us* (1951), and *The Edge of the Sea* (1956). *The Sea Around Us* was also a bestseller, translated into 30 languages, and won her a National Book Award. After the success of that book, she took a leave from the Bureau of Fisheries, supported by a Guggenheim Foundation fellowship, and soon after resigned to build a cottage in Maine and become a full-time writer. After the publication of *Silent Spring* in 1962, she dedicated herself to the campaign to influence legislation curtailing the use of insecticide, but Carson died of cancer in 1964 before any substantive results of her efforts were achieved.

Carson received numerous awards and honors, including the John Burroughs Medal (1952), the Gold Medal of the New York Zoological Society (1954), and the Conservationist of the Year Award of the National Wildlife Federation (1963). Carson has been the subject of several biographies and picture books for children.

Further Resources

Holmes, Madelyn. 2004. *American Women Conservationists: Twelve Profiles*. Jefferson, NC: McFarland.

Lear, Linda, ed. 1998. *Lost Woods: The Discovered Writing of Rachel Carson*. Boston, MA: Beacon Press.

Lear, Linda. 2009. *Rachel Carson: Witness for Nature*. 2nd ed. New York: Houghton Mifflin.

Caserio, Marjorie Constance (Beckett)

b. 1929

Organic Chemist

Education: B.Sc., Chelsea College, University of London, 1950; M.A., Bryn Mawr College, 1951, Ph.D., chemistry, 1956

Professional Experience: associate chemist, Fulmer Research Institute, England, 1952–1953; assistant to instructor, chemistry, Bryn Mawr College, 1953–1956; fellow,

California Institute of Technology, 1956–1964; assistant professor, chemistry, University of California, Irvine, 1965–1967, associate professor, 1967–1971, professor, 1971–1990; professor, chemistry, University of California, San Diego, 1990–1996, vice chancellor of academic affairs, 1990–1995, interim chancellor, 1995–1996, emerita

Marjorie Caserio is recognized as a leading physical organic chemist who has achieved excellence in research and teaching as well as governance and administration. Her research centered on reaction mechanisms in organic chemistry. She received her doctorate from Bryn Mawr College in 1956 and taught in England and in the United States before joining the new campus of the University of California, Irvine in 1965 and moving to the University of California, San Diego in 1990. She served as department head at Irvine, chair of the academic senates of both Irvine and the University of California system, and vice chancellor and interim chancellor at San Diego before retiring in 1996. She has also made important contributions to chemistry education by her innovative teaching methods. In the early 1960s, she co-authored the book *Basic Principles of Organic Chemistry*. This text had a large impact on the teaching of organic chemistry with its emphasis on spectroscopic methods. Her expertise was recognized by her appointment as a member and then chair of the Committee on Professional Training and Consultant on Graduate Education, both of the American Chemical Society.

Caserio was born in England, and entered Chelsea College, University of London, at age 15 to study podiatry, but she soon switched to chemistry rather than pursue medicine. She obtained a fellowship from the English Speaking Union to do graduate work at Bryn Mawr College. She returned to England and obtained a position at the Fulmer Research Institute, but then applied for a postdoctoral appointment at the California Institute of Technology, where she stayed for nine years. While there, she met another postdoctoral appointee, Fred Caserio; they married in 1957, the same year she became a citizen of the United States. The new campus at the University of California, Irvine started hiring in the mid-1960s, and she was the second faculty member to be hired in the chemistry department. Caserio's significant contributions to research have been recognized with the Garvan Medal of the American Chemical Society (1975), given annually to an American woman chemist.

Charles, Vera Katherine

1877–1954

Mycologist

Education: Mount Holyoke College; A.B., Cornell University, 1903

Professional Experience: mycologist, Bureau of Plant Industry, U.S. Department of Agriculture, 1903–1942

Vera Charles was among the first women hired by the U.S. Department of Agriculture in professional positions in the late nineteenth and early twentieth centuries. An expert on mushrooms, she co-authored several articles and USDA bulletins on topics such as “Mushrooms and Other Common Fungi,” “Some Common Edible and Poisonous Mushrooms,” and “Some Fungous Diseases of Economic Importance.” She studied mycology and plant pathology at Cornell University’s Agriculture School and began her long career with the USDA soon after graduation. During the 1910s and 1920s, she worked with a group of women who included the USDA’s first female mycologist, **Flora Patterson**. She and Patterson were often co-authors, and their published findings were widely known and highly regarded by their contemporaries. Charles wrote a profile of her colleague in the industry journal *Mycologia* after Patterson’s death in 1928.

Prior to the enactment of the Plant Quarantine Act in 1912, Charles inspected a large portion of the imported plants received in the department for disease and pathogen analysis; her lab was the first to identify potato wart disease on imported potatoes. In 1917, the Plant Disease Survey was organized, and Charles and Patterson were primarily responsible for all research and maintenance of the Pathological Collections. Charles had expert knowledge of Fungi imperfecti, and she spent several winters in Florida collecting mycological samples. She was interested in, and also published on, fungal pathogens in North American insects.

Charles worked as a collaborator for the division of mycology and disease survey for several years after she retired until failing eyesight forced her to give up her microscopic studies. She published a book, *Introduction to Mushroom Hunting* (1931), which went through several reprinted editions, and contributed a chapter, “The Mycologist,” to a book on *Careers for Women* (1935; edited by Catherine Filene).

Further Resources

Baker, Gladys L. 1976. “Women in the U.S. Department of Agriculture.” *Agricultural History* 50(1): 190–201.

“U.S. National Fungus Collections History.” Systematic Mycology and Microbiology, USDA. <http://www.ars.usda.gov/Services/docs.htm?docid=9399>.

Chase, (Mary) Agnes Meara

1869–1963

Botanist

Education: public schools

Professional Experience: assistant, botany, Field Museum of Natural History, 1901–1903; meat inspector, Chicago stockyards, U.S. Department of Agriculture (USDA), 1901–1903; botanical artist, Bureau of Plant Industry, USDA, 1903–1907, assistant systematic agrostologist, 1907–1923, assistant to associate botanist, 1923–1936, senior botanist, 1936–1939; custodian of grasses, National Herbarium, 1939–1963

Agnes Chase was a botanist who greatly expanded scientific data and knowledge on grasses (a scientific field known as *agrostology*), particularly those of the Northern Hemisphere. She updated and augmented the collections of grasses of the U.S. National Herbarium, which were moved to the Smithsonian Institution in 1912. She eventually donated her own personal agrostological library to the Smithsonian. Chase began her career illustrating several publications for the Field Museum of Chicago. After transferring to Washington, D.C., with the USDA in 1903, she began her collaboration with A. S. Hitchcock, a specialist in agrostology. In 1936, she succeeded Hitchcock as the principal scientist in charge of systematic agrostology, and she became a senior botanist. She was the author of more than 70 research publications. She wrote *First Book on Grasses* (1922) and *Index to Grass Species* (1962), a bibliographic register of types. She was also responsible for the 1950 revised edition of the *Manual of Grasses of the United States*.

Chase officially retired in 1939 but continued to be active at the National Herbarium for the rest of her life. Although she had little formal education, she became an acknowledged expert in her field. The Botanical Society of America awarded her a certificate of merit in 1956. She received an honorary degree from the University of Illinois in 1958, and the Smithsonian Institution named her its eighth honorary fellow. She was active in various reform movements, including women's rights, prohibition, and socialism. At one time, she was jailed for participating in a women's rights march.

Further Resources

- Baker, Gladys L. 1976. "Women in the U.S. Department of Agriculture." *Agricultural History* 50(1): 190–201.
- Bonta, Marcia M. 1995. *American Women Afild: Writings by Pioneering Women Naturalists*. College Station: Texas A&M University Press.

Chasman, Renate (Wiener)

1932–1977

Nuclear Physicist

Education: M.Sc., Hebrew University, Jerusalem, 1955, Ph.D., physics, 1959

Professional Experience: research associate, Columbia University, 1959–1962; research associate, physics, Yale University, 1962; assistant to associate physicist, Brookhaven National Laboratory, 1963–1969, physicist, 1969–1977

Renate Chasman was known for her work in the development of particle accelerators. She spent most of her career at the Brookhaven National Laboratory, where she compiled and systematized neutron cross-sections before becoming one of the key participants in the development of particle accelerators. She was the only woman physicist in her department, but she was the chief theorist for the group. The Alternating-Gradient Synchrotron (AGS) at Brookhaven was the world's highest-energy particle accelerator at that time, and Chasman was responsible for the theoretical aspects of the design for this device. She created and used computer programs for exploring the behavior of the beam during the acceleration process, and when the device was put into operation, it was found to behave in excellent agreement with her theoretical predictions. She then joined the group that explored the concept and design of superconducting storage rings for protons in the range of several hundred GeV (a GeV is defined as a giga-electron volt; *giga* means a billion; thus, several hundred billion electron volts).

Chasman and her twin sister, Edith, were born in Berlin, and the family was forced to flee to northern Europe in 1938. After the sisters graduated from high school in Sweden, they went to Israel, where Chasman received her doctorate in experimental physics. She then moved to New York to work as a research associate for the prominent female physicist **Chien-Shiung Wu** at Columbia University. She planned to follow her husband to Yale, but was told that her work visa required she leave the country for two years and then reapply for entrance. Administrators at Yale were able to intervene in her deportation, explaining to U.S. officials that the Chasmans were engaged in critical research in nuclear spectroscopy. As Renate Chasman's reputation grew, she was invited to serve on review committees at the Fermi National Accelerator Laboratory in Illinois and at the European Laboratory for Particle Physics in Switzerland. In the 1970s, she investigated the radiation from several electron synchrotrons and storage rings as a source of ultra-violet light, or x-rays, and designed storage rings especially for the production of synchrotron radiation.

In 1972, Chasman was diagnosed with malignant melanoma, but she continued to work while receiving treatment. The construction of the last project on which she worked, the National Synchrotron Light Source, was approved in the fall of 1977, but she never saw its completion. In 1985, the Brookhaven National Laboratory established a Renate W. Chasman Scholarship awarded annually to a woman who plans to resume her scientific studies after an interruption.

Chesler, Phyllis

b. 1940

Psychologist

Education: B.A., comparative literature and language, Bard College, 1963; M.A., psychology, New School for Social Research, 1967, Ph.D., psychology, 1969

Professional Experience: instructor, psychology, Institute for Developmental Studies, New York Medical College, 1965–1966; teaching fellow and research associate, neurophysiology, Brain Research Laboratory, New York Medical College, 1966–1969; private practice, psychotherapy and forensic psychology, 1970–1991; assistant professor, psychology, College of Staten Island, City University of New York (CUNY), 1969–1998, emerita professor, psychology and women’s studies, 1998–

Concurrent Positions: research associate, Graduate Department of Psychology, Yeshiva University, 1965; intern, psychotherapy, Washington Square Institute for Psychotherapy and Mental Health, 1968–1969; clinical research associate and intern, psychology and psychiatry, New York Medical College, Metropolitan, 1968–1969; instructor, United Nations Institute for Training and Research, 1979–1980; visiting instructor, Graduate Forensic Psychology Program, John Jay College of Criminal Justice, CUNY, 1997; research scholar and visiting professor, International Research Institute on Jewish Women, Brandeis University, 1997–1998

Phyllis Chesler is a psychologist, educator, writer, and feminist cultural critic who has focused on women’s mental-health issues. She has been a scholar and activist around a range of issues related to women’s social, legal, and political inequality, including abortion, rape, equal pay, healthcare, incest, battery, pornography, motherhood, spirituality, and mental health. She has taught for 30 years at the College of Staten Island in New York, and has been an invited lecturer and affiliated faculty at several other colleges and universities, as well as a psychotherapist in private practice. Her groundbreaking book, *Women and Madness*, published in 1972 at the height of the new women’s movement, traces the psychological enslavement of women by society and by the psychiatric profession that labeled women as “mad” when they did not conform to traditional feminine ideals. *Women and Madness* (reissued in 1997 and again in 2005) has sold millions of copies and is credited with initiating major reforms within the mental-health community.

Chesler is a prolific author who has published 13 books and hundreds of articles in major newspapers and magazines in both the United States and Europe. Her books include *With Child: A Diary of Motherhood* (1979), which describes her

own experience of combining feminism and motherhood. Her concern about the legal rights of mothers led to two other books: *Mothers on Trial: The Battle for Children and Custody* (1986) and *Sacred Bond: The Legacy of Baby M* (1988), which deals with the new issues of surrogacy and reproductive technologies in the 1980s. *Patriarchy: Notes of an Expert Witness* (1994) and *Letters to a Young Feminist* (1997) are collections of writings on a variety of feminist issues, the latter presented as wisdom for the next generation of activists. Her concern about women's historical participation in the oppression of other women is explored in *Woman's Inhumanity to Woman* (2002; reissued 2009). Her criticism of some aspects of western feminism itself is the subject of *The Death of Feminism: What's Next in the Struggle for Women's Freedom* (2005), which describes what she sees as the "moral failure" of a women's movement that has failed to address global women's rights issues, such as women's oppression under fundamentalist Islamic religion.

Chesler has appeared as an expert and controversial guest on numerous television shows, including the *Today Show*, *Oprah*, *Nightline*, CSPAN, the History Channel, CNN, and Court TV, and other television and radio news programs. Among her awards and honors are the Dorothy Gelgor Prize in Psychology from the New School for Social Research (1967), Positive Image of Women Award from the National Organization for Women (1978), Feminist Book Fortnight Award for *Sacred Bond* (1990), Medal of Honor Award from Veteran Feminists of America (1993), and Nike Prize at the International Book Fair (1998). She was a co-founder of the Association for Women in Psychology (1969) and the National Women's Health Network (1974), and a charter member of the Women's Forum and the Veteran Feminists of America. She has been a member of the American Association for the Advancement of Science, American Psychological Association, American Association for the Abolition of Involuntary Mental



Psychologist Phyllis Chesler has been a scholar and activist around a range of issues related to women's social, legal, and political inequality. (Bettmann/Corbis)

Hospitalization, Eastern Psychological Association, New York State Psychological Association, and National Organization for Women.

Further Resources

“The Phyllis Chesler Organization.” <http://www.phyllis-chesler.com/>.

Chilton, Mary-Dell (Matchett)

b. 1939

Molecular Biologist, Biochemist

Education: B.S., chemistry, University of Illinois, 1960, Ph.D., chemistry, 1967

Professional Experience: fellow, microbiology, University of Washington, Seattle, 1967–1969, fellow, biochemistry, 1969–1970, assistant biologist, 1971–1979, assistant to associate research professor, biology, 1973–1979; associate professor, biology, Washington University, St. Louis, 1979–1983; executive director, agricultural biotechnology, Ciba-Geigy Biotechnology Facility (now Syngenta), 1983–1991, vice president, biotechnology, 1991–

Mary-Dell Chilton is renowned for her research in plant biotechnology and the genetic engineering of agricultural crops to make them resistant to pests and environmental distress. In the 1970s, she was a member of a team of university and industry scientists who developed the first method to introduce foreign genes into plant cells and reliably produce normal fertile plants. They utilized the natural form of genetic engineering (a bacterium invades a plant and sometimes destroys it) to inject a bacterium into a crop plant to modify it genetically. Chilton and her colleagues used bacterium to transplant genes from one plant into another, altering the bacterial DNA to prevent crown gall disease and tumors from developing in the new plant. Crown gall disease can afflict a wide range of broad-leaved plants, and it causes considerable loss in certain crops, notably grapes, stone fruits, and ornamental plants. She published a paper in the June 1983 issue of *Scientific American* outlining the process the team developed. She went on to apply their research to genetically modifying other crop plants, such as maize.

Genetic engineering of plants is on the front line of research in both academic and industrial institutions, and millions of dollars are invested each year to improve crop plants. Although there has been much controversy about genetic engineering in animal research, especially the cloning of animals, there is also criticism of plant research. The fear is that agriculture will become too dependent on specific strains of plants to the extent that if those strains were wiped out by

disease, the world food supply could be in trouble. Chilton was a founder of Ciba-Geigy Corporation (now Syngenta Biotechnology, Inc., or “SBI”), located at Research Triangle Park in North Carolina, where she is vice president of biotechnology and where, in 2002, a new building was named after her. The international company, which employs 19,000 people worldwide, is “committed to sustainable agriculture through innovative research and technology.”

Chilton was elected a member of the National Academy of Sciences in 1985, just two years after the successful genetic engineering of plants was announced. She is a member of the American Academy of Arts and Sciences and a fellow of the American Society of Microbiology. She has received the Bronze Medal from the American Institute of Chemists (1960), the Hendricks Medal of the American Chemical Society (1987), and the Benjamin Franklin Medal in Life Sciences (2002).

Further Resources

Syngenta Global. “Mary-Dell Chilton, Ph.D.: Biography.” http://www.syngenta.com/en/downloads/Chilton_Biography.doc.

Chory, Joanne

b. 1955

Plant Biologist

Education: A.B., biology, Oberlin College, Ohio; Ph.D., microbiology, University of Illinois, Urbana-Champaign, 1984

Professional Experience: postdoctoral fellow, Harvard Medical School, 1984–1988; professor and Director, Plant Molecular and Cellular Biology Laboratory, Salk Institute for Biological Studies, San Diego, California, 1988–; Investigator, Howard Hughes Medical Institute, 1997–

Concurrent Positions: adjunct professor, biology, University of California, San Diego

Joanne Chory is a plant biologist whose research focuses on the genetic and biochemical explanations for how plants physically respond to light and other environmental changes. She has determined that plants have special light-sensitive receptors that respond to changes in sunlight, for example, and alter their shape, growth, and even flowering. This work has implications for identifying certain plant hormones and altering plant genetics in order to benefit commercial

agriculture through resisting disease and increasing plant yields even in shady, crowded, or off-season conditions. She is director of the Plant Molecular and Cellular Biology Laboratory at the Salk Institute for Biological Studies in San Diego and, since 1997, has been an affiliated Investigator with the Howard Hughes Medical Institute.

Chory was elected to the National Academy of Sciences in 1999 and is a fellow of the American Academy of Arts and Sciences, American Association for the Advancement of Science, European Molecular Biology Organization (EMBO), German National Academy of Sciences, and French Académie des Sciences. She has been the recipient of numerous honors and awards, including the National Academy of Sciences Award for Initiatives in Research (1994), the Charles Albert Schull Award of the American Society of Plant Physiologists (1995), and the L'Oréal-UNESCO Award for Women in Science (2000), and was named Scientific American's Research Leader in Agriculture in 2003.

Further Resources

Salk Institute. Faculty website. http://www.salk.edu/faculty/faculty_details.php?id=12.

Howard Hughes Medical Institute. "Joanne Chory, Ph.D." http://www.hhmi.org/research/investigators/chory_bio.html.

Clark, Eugenie

b. 1922

Zoologist, Ichthyologist

Education: B.A., zoology, Hunter College, 1942; M.A., zoology, New York University, 1946; Ph.D., zoology, New York University, 1950

Professional Experience: chemist, Celanese Corporation of America, New Jersey, 1942–46; chemist, Department of Endocrinology, Cornell Medical School, New York, 1946; oceanographic chemist, Philippine Expedition, U.S. Fish and Wildlife Service, 1947; research assistant, ichthyology, Scripps Institution of Oceanography, University of California, 1946–1947; research assistant to associate, animal behavior and ichthyology, American Museum of Natural History, 1947–1981; instructor, biology, Hunter College, New York, 1953–1954; pharmacologist, Nepera Corporation, New York, 1954–1955; executive director, Cape Haze Marine Laboratory, Florida, 1955–1967; associate professor, zoology, City University of New York, 1966–1967; associate professor to professor, zoology, University of Maryland, 1968–1992; consultant and director emerita, Mote (formerly Cape Haze) Marine

Laboratory, Florida, 1986–; senior research scientist and professor emerita, Department of Biology (formerly Zoology), University of Maryland, 1992–

Concurrent Positions: swimming instructor, Shelton Athletic Club, New York, 1943–1944; director, National Science Foundation (NSF) summer science training programs, Cape Haze Marine Laboratory, Florida, 1955–1965; research associate, New England Institute for Medical Research, 1956–1966, visiting professor, 1966–1968; consultant/participant on television and film documentaries, 1967–; founding member, Marine Biological Laboratory, Hebrew University, Israel, 1969–1979; visiting professor, zoology, Hebrew University, Jerusalem, 1972



Zoologist and ichthyologist, Eugenie Clark.
(Courtesy of University Publications,
University of Maryland)

Eugenie Clark is one of the foremost marine biologists in the world, specializing in sharks, the reproductive behavior of fishes, morphology and taxonomy of plecognath fishes, and Red Sea fishes. Known worldwide as “the Shark Lady,” she has successfully combined scientific research with imparting scientific information to the general public. Clark became interested in fish when, as a child, she spent Saturdays at the New York Aquarium. She began to keep an aquarium at home, collecting a variety of fish, and went on to study biology in high school and then zoology at Hunter College. After receiving her master’s degree, she was hired by the Fish and Wildlife Service for an expedition to the Philippines, but at a stop in Hawaii she was notified that she would not be continuing on as one of her superiors did not want to hire a woman. She returned to New York to pursue the Ph.D., studying the mating habits of platies and swordfishes, and producing the first test-tube fishes. At the time she received her doctorate, Clark was one of only three female ichthyologists in the United States.

As part of her graduate education, Clark attended summer programs at the University of Michigan Biological Station and the Marine Biological Laboratory at Woods Hole, Massachusetts. She participated in a post–World War II

government project studying and counting fish in the South Pacific and, after receiving her doctorate, traveled to Egypt to study fish in the Red Sea, where she identified three new species. She published an early bestselling autobiography detailing her work and adventures, entitled *Lady with a Spear* (1953). Philanthropist Anne Vanderbilt read the book and invited Clark to Florida to direct a new marine laboratory to be funded by the Vanderbilt family. Clark served as director and later consultant to the Cape Haze Marine Laboratory, where she began to specialize in the study of sharks, collecting and studying hundreds of specimens, both dead and alive. She became well-known as “the Shark Lady” in both academic and popular scientific circles and publications (such as through *National Geographic*). In 1968, Clark took a teaching position in zoology at the University of Maryland and, soon after, published another autobiography, *The Lady and the Sharks* (1969).

Clark lectures internationally at conventions, schools, and universities, and has consulted on or made appearances in hundreds of radio, television, and documentary programs on sharks and marine environments, such as the National Geographic Society special on “The Sharks” (1981–1982), BBC–Discovery Channel’s “Reef Watch—Live from the Red Sea” (1988), National Geographic Explorers on marine life (1987–1990), and the IMAX film *Search for the Great Sharks* (1993). She is a member of dozens of underwater, zoological, and scientific organizations, and has received numerous awards and honors, including the Cousteau Award (1973), Gold Medal of the Society of Women Geographers (1975), John Stoneman Marine Environmental Award (1982), Lowell Thomas Award of the Explorers Club (1986), Franklin L. Burr Award of the National Geographic Society (1993), and the Medal of Excellence of the American Society of Oceanographers (1994). At least four species of fish have been named for Clark and, in addition to being profiled in numerous books and articles, she is the subject of several biographies for children.

Further Resources

“The Shark Lady.” <http://www.sharklady.com>.

Clarke, Edith

1883–1959

Electrical Engineer

Education: A.B., Vassar College, 1908; University of Wisconsin, 1911–1912; M.S., electrical engineering, Massachusetts Institute of Technology, 1919

Professional Experience: high school teacher, mathematics and physics, 1909; Marshall College, 1910–1911; computer, American Telephone and Telegraph (AT&T), 1912–1918; supervisor, Turbine Engineering Department, General Electric Company (GE), 1920–1921; instructor, physics, Constantinople Woman’s College, Turkey, 1921–1922; engineer, GE, 1922–1945; professor, electrical engineering, University of Texas, Austin, 1947–1956

Edith Clarke was a mathematician and theorist recognized as an expert in the design of large electrical power stations. She developed calculating devices that allowed the prediction of system reactions to extraordinary events without solving the same sets of equations repeatedly. She patented such a calculating device in 1925. She authored numerous articles that were recognized for their high merit; two of them received prizes from the American Institute of Electrical Engineers (AIEE). Her book, *Circuit Analysis of A-C Power Systems* (1943, 1950), became a standard graduate text. She spent most of her career as an engineer at General Electric before joining the faculty at the University of Texas, Austin as the first woman to teach electrical engineering in a university in the United States.

After receiving her undergraduate degree, Clarke taught mathematics at a high school and a college for several years before deciding to pursue a career in engineering. She studied civil engineering at the University of Wisconsin for one year, and was the first woman to receive a master’s degree in electrical engineering from MIT. She found it difficult to find employment as an engineer, however, and worked for a few years as a “computer” at AT&T, supervising a group of women performing computations for research engineers in an era before the development of the electronic calculator and computer. After teaching abroad for one year, she was hired by GE as an engineer. She invented and patented a device called the “Clarke calculator” for solving line equations. She was the first woman elected a fellow of the AIEE in 1948, and she received the Society of Women Engineers’ Achievement Award in 1954.

Further Resources

Agnes Scott College. “Edith Clarke.” Biographies of Women Mathematicians. <http://www.agnesscott.edu/lriddle/women/clarke.htm>.

Cleave, Mary L.

b. 1947

Environmental Engineer, Astronaut

Education: B.S., biological sciences, Colorado State University, 1969; M.S., microbial ecology, Utah State University, 1975, Ph.D., civil and environmental engineering, 1979



Astronaut Mary Cleave. (NASA)

Professional Experience: research staff, Ecology Center and Utah Water Research Laboratory, Utah State University, 1971–1980; astronaut, National Aeronautics and Space Administration (NASA), 1980–1990, deputy project manager, SeaWiFS, Laboratory for Hydrospheric Processes, NASA Goddard Space Flight Center, 1991–, deputy associate administrator (advanced planning), Office of Earth Science, and associate administrator, Science Mission Directorate, NASA Headquarters, 2004–2007

Mary Cleave was one of the first eight women astronauts selected between 1978 and 1980, and she flew on two *Atlantis* missions (1985 and 1989).

In the mid-1970s, NASA modified its requirements to allow applicants without jet pilot experience, but with advanced scientific training. Many women scientists and engineers applied. Cleave earned her engineering doctorate in 1979 and was selected for the astronaut program in 1980. Cleave's earlier work focused on environmental engineering questions concerning algae growth, sand and salt flow, and the effects on fish and plant life in the Great Basin Desert of Utah. On the *Atlantis* 1989 mission, she was involved in the deployment of the *Magellan* planetary probe that would map over 95% of the surface of Venus. She has studied planetary atmospheric and magnetic fields among other geological observations. She left the astronaut program in 1990, but continued to work for NASA in the Laboratory for Hydrospheric Processes in Maryland, specializing in environmental problems through a project called SeaWiFS (Sea-viewing, Wide-Field-of-view Sensor), a satellite that monitors ocean color for signs of vegetation growth for insight into global climate and other changes.

Cleave has been honored with the American Astronautical Society Flight Achievement Award (1989) and the NASA Exceptional Achievement Medal (1994), named NASA Engineer of the Year (1998), and nominated by the National Women's History Project as one of their "Women Taking the Lead to Save Our Planet" (2009). She has been a member of the Water Pollution Control Federation,

the Society for Professional Engineers, the Association of Space Explorers, and Women in Aerospace. Since 2007, she has served on the board of directors of Sigma Space Corps, which provides services and products to the aerospace industry, including NASA.

Further Resources

Kevles, Bettyann H. 2003. *Almost Heaven: The Story of Women in Space*. New York: Basic Books.

National Aeronautics and Space Administration. "Mary L. Cleave (Ph.D., P.E.)." <http://www.jsc.nasa.gov/Bios/htmlbios/cleave-ml.html>.

Cobb, Geraldyn M.

b. 1931

Aviator, Astronaut Consultant

Education: student, Oklahoma College for Women, 1948

Professional Experience: teacher, aviation school, 1949; self-employed charter pilot, 1950; charter pilot, commercial and military planes, Fleetway, Inc., chief pilot, South American operations, 1951–1955; chief pilot, Executive Aircraft, Inc; executive pilot and advertising and sales promotion manager, Aero Design & Engineering Company, 1958–1964; consultant, astronaut qualifying tests, National Aeronautics and Space Administration (NASA), 1960–1961, consultant, 1961–1962; private and commercial pilot

Geraldyn "Jerrie" Cobb was a commercial pilot who helped develop astronaut training tests for women, but never made a space flight. More than 20 years before astronaut **Sally Ride** made her historic launch in 1983, Cobb worked with NASA to develop physical and mental tests for female pilots who wished to enter the astronaut training program. Between 1957 and 1960, Cobb set international records for speed, altitude, and distance in the twin-engine class of airplanes, piloting Aero Commander planes, and was considered one of the premier women pilots of that era. Although numerous women had ferried military planes overseas during World War II, the military services had no data on the physical capabilities of women pilots, and none of the branches of the military trained women pilots.

Cobb originally worked with a privately funded organization to modify NASA's astronaut tests for women. She and 12 other women passed the tests, often surpassing the performance of men, but NASA would not allow the women into the astronaut program. Although Cobb participated in congressional hearings urging the

program to select women astronauts, the project was canceled. By this time, the Russians had several women in their astronaut program, and Valentina Tereshkova became the first woman in space when she orbited the Earth for three days in 1963. Cobb went on to work briefly with NASA directly as a general consultant and consulted for the Federal Aviation Administration as well.

Cobb became interested in flying early, and when she was 12 years old, her father installed pedal blocks and seat cushions so she could fly his biplane. She earned her private pilot's rating when she was only 16 years old and, leaving college after one year, received her commercial pilot's and flight instructor's licenses and obtained a job teaching in an aviation school. One of the most dangerous jobs she had was ferrying World War II fighter planes that the Navy had sold to the Peruvian air force. Flying in the Andes is considered one of the most challenging experiences for any pilot, and she made solo trips there for several years when she worked for Fleetway, Inc. She also tested reconditioned commercial and military planes and flew them throughout the world for the same company. She became engaged to her boss, Jack Ford, but after they broke their engagement, she left the company in 1955. She achieved her numerous flight records while employed as a pilot for Aero Design & Engineering Company. She went on to fly humanitarian missions and conduct surveys of new routes in South America and other remote regions. In 1999, the National Organization for Women launched a failed campaign to give Cobb one more chance to go into space.

Several books have been written about women in the early years of the space race, and Cobb published two autobiographies: *Woman into Space: The Jerrie Cobb Story* (1963) and *Jerrie Cobb, Solo Pilot* (1997). Cobb is the recipient of the Amelia Earhart Gold Medal of Achievement (1949), Amelia Earhart Memorial Award (1957), Pilot of the Year by the National Pilots Association (1959), Harmon International Trophy (1973), and Bishop Wright Air Industry Award (1979), and has been honored by the governments of France, Columbia, Brazil, Peru, and Ecuador for her aviation and humanitarian achievements. In 1981, she was nominated for the Nobel Peace Prize, and in 2007, she received an honorary doctorate from the University of Wisconsin, Oshkosh.

Further Resources

Ackmann, Martha. 2004. *The Mercury 13: The True Story of Thirteen American Women and the Dream of Space Flight*. New York: Random House.

Nolen, Stephanie. 2002. *Promised the Moon: The Untold Story of the First Women in the Space Race*. New York: Avalon.

Weitekamp, Margaret A. 2005. *Right Stuff, Wrong Sex: America's First Women in Space Program*. Baltimore, MD: Johns Hopkins University Press.

"The Jerrie Cobb Foundation, Inc." <http://www.jerrie-cobb-foundation.org/>.

Cobb, Jewel Plummer

b. 1924

Cell Biologist

Education: student, University of Michigan, 1941–1942; B.A., Talladega College, 1944; M.S., New York University, 1947, Ph.D., cell biology, 1950

Professional Experience: instructor, anatomy, and director, Tissue Culture Laboratory, University of Illinois, 1952–1954; research instructor, surgery, New York University, 1955–1956, assistant professor, 1956–1960; professor, Biology Department, Sarah Lawrence College, 1960–1969; dean and professor, zoology, Connecticut College, 1969–1976; dean and professor, biological science, Douglass College (Rutgers University), 1976–1981; president and professor, biological sciences, California State University, Fullerton, 1981–1990, president emerita, 1990–; trustee professor, California State University, Los Angeles, 1990–

Concurrent Positions: member, Marine Biological Institute, Woods Hole Oceanographic Institution, 1972–; member, U.S. Department of State Advisory Committee on Oceans and International Environment and Science Affairs, 1980–1990; principal investigator, Southern California Science and Engineering ACCESS Center and Network, 1991–; chair, Committee on Women in Science and Engineering, National Research Council, 1993–; ASCEND Project, Science Technology Engineering Program (STEP) Up for Youth, California State University, Los Angeles, 2001–

Jewel Plummer Cobb is a researcher in cell biology, an educator who develops programs to encourage ethnic minorities and women in the sciences, and an administrator who has headed several colleges and universities. Her research in cell biology has focused on melanin, a brown or black skin pigment; she also studies the causes and growth of normal and cancerous pigment cells. In addition, she has studied the effects of newly discovered cancer chemotherapy drugs on human cancer cells. One of her first accomplishments was establishing and directing the Tissue Culture Laboratory at the University of Illinois, and she managed to continue her research during appointments at various other colleges even though her positions often required heavy administrative responsibilities. When she was selected as president of California State University, Fullerton, however, she had to reduce her involvement in research. As president, she established the first privately funded gerontology center in Orange County, lobbied the state legislature to approve the construction of new science buildings, and worked to ensure a more diverse student body. She is also the director of a program committed to bringing science education to inner-city middle school students, the Science Technology Engineering Program (STEP)

Up for Youth ASCEND project. Under her leadership, the program received a significant three-year grant from the National Science Foundation in 2001.

Cobb became interested in science at an early age owing to the example of her physician father. She selected a career in biology in her sophomore year in high school when she first looked through a microscope and went on to the University of Michigan in the early 1940s. She left Michigan after three semesters, however, due to their policy of segregated dormitories. She transferred to Talladega College in Alabama, earning her bachelor's degree, and went on to graduate studies with a fellowship to New York University. Initially intending to become a doctor, she decided to pursue biological research instead.

Cobb has received 18 honorary degrees and numerous awards for her service to organizations dedicated to increasing the presence of women and minorities in the sciences. She was elected to membership in the Institute of Medicine of the National Academy of Sciences and is a fellow of the New York Academy of Sciences and the American Association for the Advancement of Science. She is a member of the Association of Women in Science and the Tissue Culture Association.

Further Resources

Ehrhart-Morrison, Dorothy. 1997. *No Mountain High Enough: Secrets of Successful African American Women*. Berkeley, CA: Conari Press.

Cohn, Mildred

1913–2009

Biochemist

Education: A.B., Hunter College, 1931; A.M., Columbia University, 1932, Ph.D., chemistry, 1938

Professional Experience: junior science aide, National Advisory Committee on Aeronautics, 1932–1935; biophysical assistant, George Washington University medical school, 1937–1938; biophysicist, Cornell University medical school, 1938–1941, research associate, 1941–1946; biochemist, School of Medicine, Washington University, St. Louis, 1946–1957, associate professor, 1958–1960; associate professor, medical school, University of Pennsylvania, 1960, professor, biophysics and physical biochemistry, 1960–1982; senior scientist, Fox Chase Cancer Center, 1982–1985; emeritus professor

Concurrent Positions: career investigator, American Heart Association, 1964–1978

Mildred Cohn was a biochemist whose research focused on metabolic studies with stable isotopes, mechanisms of enzymatic reactions, and electron spin. Cohn's most important contribution to science was her work, in the 1950s, on using nuclear magnetic resonance (NMR) to study the function of enzymes. She pursued this work at Washington University in St. Louis, where she worked in the biochemistry department with **Gerty T. Cori** and Carl Ferdinand Cori, winners of the 1947 Nobel Prize in Physiology or Medicine.

The daughter of Russian immigrants, Cohn showed an early interest in science and entered college to study chemistry and physics at the age of only 14. At the time, even the chair of the Hunter College chemistry department believed that he was training female students to be science teachers, not scientists. By age 17, she had received her bachelor's degree and had gone on to graduate work at Columbia. She was unable to support herself through teaching assistantships since those positions were reserved for male students. She lived at home and worked odd jobs to complete her master's degree, but was forced to leave school to find paid employment. In 1932, she went to work for the National Advisory Committee for Aeronautics at Langley Field, Virginia, where she worked as a research assistant, and the only woman, in the engine division. She returned to Columbia and expected to find another industry research position after completing her Ph.D. in chemistry in 1937, but most of the large research companies would not even interview a Jewish woman at that time. She instead found research laboratory positions in college medical schools before taking her first academic appointment in 1958 at Washington University, where her husband, theoretical physicist Henry Primakoff, had also been offered a position. She later commented that there were advantages to working as an independent researcher in the early years of her career, as she had more flexibility for raising her children and could pursue long-term projects without the publishing pressures



Biochemist Mildred Cohn was the first female career investigator for the American Heart Association. (Bettmann/Corbis)

of an academic position. Cohn retired from teaching in 1982 and subsequently had a three-year affiliation at the Fox Chase Cancer Center as a senior scientist.

Cohn was elected to membership in the National Academy of Sciences in 1971 and was awarded the Garvan Medal of the American Chemical Society (1963), the National Medal of Science (1982), and the Distinguished Award of the College of Physicians (1987). She was a senior member of the Institute for Cancer Research (1982–1985) and served as president of the American Society of Biological Chemists (1978–1979). She was a member of the American Philosophical Society, the American Academy of Arts and Sciences, the American Chemical Society, and the Biophysical Society, and was president of the American Society of Biological Chemistry (1978–1979). She was the mother of three children, all of whom also earned Ph.D.s in scientific disciplines.

Further Resources

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

Cole, Johnnetta (Betsch)

b. 1936

Anthropologist

Education: student, Fisk University, 1953; B.A., sociology, Oberlin College, 1957; M.A., Northwestern University, 1959, Ph.D., anthropology, 1967; LLD, Bates College, 1989

Professional Experience: instructor, University of California, Los Angeles, 1964; assistant professor, anthropology and director, black studies, Washington State University, Pullman, 1967–1970; professor, anthropology and Afro-American studies, University of Massachusetts, Amherst, 1970–1983, provost of undergraduate education, 1981–1983; visiting professor, Hunter College, City University of New York (CUNY), 1983–1984, professor, anthropology, 1983–1987, director, Latin American and Caribbean Studies, 1984–1987; president, Spelman College, 1987–1997; professor, anthropology and African American studies, Emory University, 1999–2002; president, Bennett College, 2002–2007; director, National Museum of African Art, Smithsonian Institution, 2009–

Concurrent Positions: chair, United Way of America, 2004–2006

Johnnetta Cole is a cultural anthropologist whose research focuses on African and African American women and families. Cole also had a distinguished career as an



Johnnetta Cole, a cultural anthropologist whose research focuses on African and African-American women and families, served as president of both Spelman College and Bennett College. (AP/Wide World Photos)

administrator, serving as president of the only two remaining historically black female colleges in the United States: Spelman College in Atlanta, Georgia, and Bennett College in Greensboro, North Carolina. She was born into a prominent middle-class family in segregated Jacksonville, Florida. Her great-grandfather had helped to found an African American insurance company in 1901—a local library and a YMCA were named for him—but even though her family was a prominent one, she attended segregated public schools. At the age of 15, she was accepted at the predominantly black Fisk University in Nashville, Tennessee, under its early admissions program. She went on to Oberlin, her first experience in a predominantly white institution, and then to graduate school at Northwestern.

After receiving her master's degree in 1959, she married fellow student Robert Cole and the couple departed for Liberia to gather data for their doctoral projects, his in economics and hers in anthropology. When they returned to the United States, her husband completed his doctorate and secured a position at Washington State University, Pullman. Johnnetta taught part-time at the same institution and received her doctorate from Northwestern in 1967. She also conducted fieldwork in Cuba, Haiti, and Grenada, and was involved in a Peace Corps training project at San Francisco State University in 1965. She eventually relocated to the University

of Massachusetts, where she developed a black studies program and her husband taught at Amherst College in Massachusetts. She was selected president of Spelman College in 1987. Even though Spelman College is a private, all-girls school, Cole was the first black woman to serve as president. She taught women's studies and African American studies at Emory University before becoming President of Bennett College in 2002.

Her fieldwork has included studies of a Chicago black church, labor in Liberia, racial and gender inequality in Cuba, Caribbean women, female-headed households, the way women age, and the Cape Verdean culture in the United States. In her book *Conversations: Straight Talk with America's Sister President* (1993), she discussed some of the problems faced by African American women, such as racism and sexism, as well as ways to deal with those problems. With Beverly Guy-Sheftall, she co-authored *Gender Talk: The Struggle for Women's Equality in African American Communities* (2003). In addition, she has edited three textbooks on anthropology: *Anthropology for the Eighties* (1982), *All American Women: Lines That Divide, Ties That Bind* (1986), and *Anthropology for the Nineties: Introductory Readings* (1988).

Cole is a fellow of the American Anthropological Association and a member of the Association of Black Anthropologists and the National Council of Negro Women, and has served on the board of directors for the Global Fund for Women. She has received numerous honorary degrees and awards for her educational and community service, including the McGovern Behavioral Science Award from the Smithsonian Institute (1999). In 2004, the Johnnetta B. Cole Global Diversity & Inclusion Institute was founded at Bennett College, and Professor Cole continues to serve on the Board of Directors.

Further Resources

"Johnnetta B. Cole Global Diversity & Inclusion Institute." <http://www.jbcinstitute.org/>.

Collins, Eileen

b. 1956

Astronaut

Education: B.A., mathematics and economics, Syracuse University, 1978; M.S., operations research, Stanford University, 1986; M.A., space systems management, Webster University, 1989

Professional Experience: instructor pilot, Vance Air Force base, Oklahoma, 1947–1982; aircraft commander and instructor pilot, Travis Air Force base, California, 1983–1984; assistant professor, mathematics, and instructor pilot, U.S. Air Force



President Bill Clinton greets astronaut Eileen Collins at a White House ceremony in 1998. Collins was the first female space shuttle pilot and the first female commander of a shuttle mission. (AP/Wide World Photos)

Academy, Colorado, 1986–1989; astronaut, National Aeronautics and Space Administration (NASA), 1991–2006

Eileen Collins is an engineer and astronaut who logged over 870 hours in space as part of four space flights: *Discovery* (1995), *Atlantis* (1997), *Columbia* (1999), and *Discovery* (2005). For the first *Discovery* flight in 1995, which docked with the Russian space station *Mir*, Collins was the first woman to pilot the space shuttle. For the *Columbia* flight in 1999, Collins was the first female shuttle commander. Collins received her pilot training through the Air Force, graduating from the Air Force Undergraduate Pilot Training program in 1979 and the Air Force Test Pilot School in 1990. Between those years, she worked as an instructor pilot and Air Force Academy mathematics professor. She became an astronaut in 1991. Collins retired from the Air Force in 2005 and from NASA in 2006.

Collins dreamed of flying and of becoming an astronaut as a child, but her family did not have money for college. She attended community college and, at the age of 20, worked odd jobs to pay for flying lessons. She received an Air Force ROTC scholarship to attend Syracuse University in New York, where she studied math and economics, and went on to the pilot training program at Vance Air Force Base in Oklahoma. She was one of only four women in her class of more than 300 and became the Air Force's first female flight instructor, teaching in Oklahoma and then at Travis Air Force Base in California. In California, she attended the Air Force Institute of Technology and went on to earn a master's degree in operations research from Stanford University. She relocated to the U.S. Air Force Academy in Colorado as an instructor pilot and then earned a master's degree in space systems management from Webster University in St. Louis, Missouri. While attending the Air Force Test Pilot School at Edwards Air Force Base in California, she applied for and was accepted into the NASA astronaut program. She has said that she considers the female military pilots during World War II, as well as the first generation of women astronauts, role models who paved the way for her to become an astronaut and to become the first female shuttle pilot and commander.

Collins has received numerous awards and honors, including a President's Medal from the New York Institute of Technology, Defense Superior Service Medal, Distinguished Flying Cross, Defense Meritorious Service Medal, Air Force Meritorious Service Medal with one oak leaf cluster, Air Force Commendation Medal with one oak leaf cluster, Armed Forces Expeditionary Medal for service in Grenada (Operation Urgent Fury, October 1983), French Legion of Honor, NASA Outstanding Leadership Medal, NASA Space Flight Medals, Free Spirit Award, and National Space Trophy. She was inducted into the National Women's Hall of Fame in 1998.

Further Resources

Kevles, Bettyann H. 2003. *Almost Heaven: The Story of Women in Space*. New York: Basic Books.

National Aeronautics and Space Administration. "Eileen Marie Collins (Colonel, USAF, RET.)." <http://www.jsc.nasa.gov/Bios/htmlbios/collins.html>.

Colmenares, Margarita H.

b. 1957

Environmental Engineer

Education: student, business, California State University, Sacramento; student, Sacramento City College; B.Sc., civil engineering, Stanford University, 1981

Professional Experience: field construction engineer, Chevron Corporation, 1981, recruiting coordinator (San Francisco) field construction engineer (Salt Lake City), foreign training representative, 1983–1986, compliance representative and lead engineer in environmental cleanup (El Segundo refinery), 1986, air quality specialist (El Segundo), 1989–1996; director of corporate liaison, U.S. Department of Education, 1996–

Concurrent Positions: White House fellow 1991–1992

Margarita Colmenares is the first Hispanic engineer to be selected as a White House fellow since the program was established in 1964, and during her 1991–1992 fellowship years, she served as special assistant to the deputy secretary of education in Washington, D.C. She was also the first woman president of the Society of Hispanic Professional Engineers. She received her first assignment specifically involved in environmental protection as an engineer charged with ensuring compliance with federal, state, and local environmental, safety, fire, and health regulations at Chevron Corporation's facilities. She directed an environmental cleanup project at the Chevron refinery in El Segundo and was then promoted to air quality specialist in 1989. At this time, she also was national president of the Society of Hispanic Professional Engineers (SHPE) and persuaded Chevron to give her a one-year paid leave while she was president. During her term of office, she promoted education, especially engineering education, for Hispanics. In 1989, she also participated in the National Hispana Leadership Initiative, a program for women that included training sessions in public policy at Harvard's John F. Kennedy School of Government.

Colmenares was born in Sacramento of parents who had emigrated from Mexico. Her parents sent her and her siblings to parochial schools in order to provide the best education for them, and she was selected in high school for a program for inner-city youth to work at Xerox Corporation. She entered California State University, Sacramento to study business courses, but discovered an interest in engineering. She filled in gaps in her education with courses in chemistry, physics, and calculus at Sacramento City College before entering the Engineering School at Stanford University. While attending school, she also worked part-time with the California Department of Water Resources inspecting the structural conditions of dams and water-purifying plants. She won five scholarships to attend Stanford and simultaneously worked for the Chevron Corporation in Texas and California in that company's cooperative education program.

When Colmenares received the White House fellowship in 1991–1992, she also requested an assignment with the Department of Education. In 1996, she accepted a position as director of corporate liaison for the U.S. Department of Education, where she works with business leaders and organizations around the country to

engage their support for education. She has received recognition for her commitment to the Hispanic community. She founded the San Francisco chapter of SHPE in 1982 and served as president of that organization. In 1990 and 1992, *Hispanic Business* recognized her as one of the 100 most influential Hispanics in the country.

Further Resources

Ambrose, Susan A. et al. 1997. *Journeys of Women in Science and Engineering: No Universal Constants*. Philadelphia, PA: Temple University Press.

Colson, Elizabeth Florence

b. 1917

Anthropologist

Education: B.A., anthropology, University of Minnesota, 1938, M.A., 1940; M.A., Radcliffe College, 1941, Ph.D., social anthropology, 1945

Professional Experience: assistant social science analyst, War Relocation Authority, Arizona, 1942–1943; research assistant, Peabody Museum, Harvard University, 1944–1945; senior research officer, Rhodes-Livingstone Institute of Social Research, Northern Rhodesia, 1946–1947, director, 1948–1951; senior lecturer, social anthropology, Manchester University, England, 1951–1953; associate professor, anthropology, Goucher College, Maryland, 1954–1955; associate professor and research associate, African studies, Boston University, 1955–1959, part-time research associate, 1959–1962; professor, anthropology, Brandeis University, 1959–1963; visiting professor, Northwestern University, 1963–1964; professor, anthropology, University of California, Berkeley, 1964–1984, emeritus

Concurrent Positions: fellow, Center for Advanced Study in the Behavioral Sciences, Stanford University, 1967–1968; lecturer, University of Rochester, 1973; fellow, California Institute of Technology, 1975–1976; lecturer, University of New Mexico, 1978; visiting professor, University of Zambia, 1987; visiting senior research fellow, Refugee Studies Programme, Queen Elizabeth House, Oxford, England, 1988—1989

Elizabeth Colson has investigated social change in central Africa and in the north-west United States; in particular, her work was a forerunner to anthropological research on African Americans. Her main research interest has been a longitudinal study of the Gwembe Tonga of Zambia through a period of forced resettlement and political reorganization. Whether in Africa or in the United States (such as among the Pomo, Makah, or Hopi-Navajo Indians, or Japanese Americans during

World War II), her research has looked into the effects of assimilation, relocation, and economic and political change on women, families, and religious life. In common with many anthropologists, whose work often takes them around the globe, she has held a variety of jobs in academia, institutes, fellowships, and special projects. She has had unique appointments as director of an institute in Northern Rhodesia and as a senior lecturer at Manchester University in England. She published dozens of articles and reports, and authored or edited more than 15 books, including *Life among the Cattle-Owning Tonga: The Material Culture of a Zambian Tribe* (1949), *The Makah Indians: A Study of an Indian Tribe in Modern American Society* (1953), *Marriage and Family among the Plateau Tonga of Northern Rhodesia* (1958), *The Social Consequences of Resettlement: The Impact of the Kariba Resettlement upon the Gwembe Tonga* (1971), *Autobiographies of Three Pomo Women* (1974), and *For Prayer and Profit: The Ritual, Economic, and Social Importance of Beer in Gwembe District, 1950–1982* (co-author, 1988).

Colson was elected to the National Academy of Sciences in 1977. She received the Morgan Lectureship at the University of Rochester (1973), the Outstanding Achievement Award of the Society of Woman Geographers (1982), the Rivers Memorial Medal of the Royal Anthropological Institute (1982), and the Distinguished Africanist Award of the American Association for African Studies (1988). She was elected an honorary fellow of the Royal Anthropological Institute, a fellow of the American Anthropological Association, and a fellow of the American Association for the Advancement of Science. She has been a member of the American Ethnological Society, Society for Political and Legal Anthropology, American Society for Applied Anthropology, American Association of African Studies, American Academy of Arts and Sciences, Society of Women Geographers, and Association of Social Anthropologists. She received honorary degrees from Brown University (1979), the University of Rochester (1985), and the University of Zambia (1992).

Further Resources

University of California, Berkeley. "Seventh Emeritus Lecture Honoring Elizabeth F. Colson." Anthropology Emeritus Lecture Series. (20 October 1997). <http://www.lib.berkeley.edu/ANTH/emeritus/colson/index.html>.

Colwell, Rita (Rossi)

b. 1934

Marine Microbiologist

Education: B.S., bacteriology, Purdue University, 1956, M.S., genetics, 1958; Ph.D., marine microbiology, University of Washington, Seattle, 1961



Marine microbiologist Rita Colwell is awarded the National Medal of Science by President George W. Bush in 2007. (AP/Wide World Photos)

Professional Experience: research assistant professor, University of Washington, 1961–1964; visiting assistant professor, Georgetown University, 1963–1964, assistant to associate professor, biology, 1964–1972; professor, microbiology and biotechnology, University of Maryland, 1972–, director, University of Maryland Biotechnology Institute (UMBI), 1987–1991, president, 1991–1998; director, National Science Foundation, 1998–2004; chair and chief scientist, Canon U.S. Life Sciences, Inc., 2004–

Concurrent Positions: consultant, Environmental Protection Agency, 1975–; director, Maryland Sea Grant Program, 1978–1983; vice president of academic affairs, University of Maryland, 1983–1987; member, National Science Board, 1984–1990; chairman, National Science Board, 1996–1998; councilor, National Academy of Sciences, 2008–2011

Rita Colwell is a leader in marine biotechnology, a field that involves the application of molecular techniques to marine biology for harvesting medical, industrial, and aquaculture products from the sea. Her goal is to improve the environment and human health by understanding, preserving, and using the ocean's resources, and she believes the future of marine biotechnology lies in new drugs made from marine sources, new methods of cost-effective fish culture, seaweed genetics, and improved biotechnological waste recycling. Her work led to the creation of the University of Maryland Biotechnology Institute, established in 1987 with Colwell as director and then president of this cutting-edge research center. In 1998, she was appointed by President Clinton to be director of the National Science Foundation (NSF), the first woman to hold this position. At the NSF, she showed a commitment to K–12 science and mathematics education, and to increasing the presence of women and minorities in science. She left her post at the NSF in February 2004 to become chair of Canon U.S. Life Sciences, Inc., a new organization that seeks to apply molecular research to medical diagnostic applications.

Colwell was the seventh of eight children of parents who emphasized the importance of a good education. She obtained a full scholarship to study at Purdue, where she majored in bacteriology. She married in her senior year of college and planned to continue in the master's program while her husband, Jack Colwell, completed his degree in physical chemistry. However, the head of the bacteriology department did not want to give fellowship money to a woman. She was accepted into the master's program in genetics instead. After she and her husband both received doctorates from the University of Washington, Colwell obtained a grant from the National Science Foundation and joined her husband in Canada to conduct research. The Colwell Massif geological site in Antarctica is named for her work in the polar regions.

Colwell has authored, co-authored, or edited 16 books and hundreds of scientific papers. She also produced the award-winning film, *Invisible Seas*. She was a member of the National Science Board (1984–1990), which advises the federal government on science policy. She is a fellow of the American Association for the Advancement of Science, the Society for Industrial Microbiology, and the American Academy of Microbiology. She is a member of the American Society for Microbiology (president, 1984–1985) and the Society for Invertebrate Pathology, and the recipient of the Fisher Award of the American Society for Microbiology (1985), Gold Medal Award of the International Institute of Biotechnology (1990), Phi Kappa Phi National Scholar Award (1993), Outstanding Service Award from the American Institute of Biological Sciences (2004), and National Medal of Science (2006). She was elected to the National Academy of Sciences (NAS) in 2000, and in 2008 she began a three-year term as a councilor to the NAS.

Further Resources

University of Maryland. Faculty website. <http://chemlife.umd.edu/about/circleofdiscovery/ritarcolwell>.

Conway, Lynn Ann

b. 1938

Computer Scientist, Electrical Engineer

Education: B.S., Columbia University, 1962, M.S., electrical engineering, 1963

Professional Experience: staff researcher, IBM Corporation, 1964–1969; senior staff engineer, Memorex Corporation, 1969–1973; research engineer, Xerox Corporation, 1973–1983; chief scientist and assistant director of strategic computing, Defense Advisory Research Projects Agency (DARPA), 1983–1985; professor, electrical engineering and computer science and associate dean of the College of Engineering, University of Michigan, 1985–1998, emerita

Concurrent Positions: visiting associate professor, electrical engineering and computer sciences, Massachusetts Institute of Technology (MIT), 1978–1979

Lynn Conway is famous for two major developments in computer circuitry, the first being the invention of a new approach to the design of integrated computer circuit chips that simplified and demystified the design process. Her second major achievement was a new method of chip fabrication that enabled designers to obtain rapidly prototypes with which to test their hardware and software designs. The latter development was reported in the textbook *Introduction to VLSI Systems* (1980, co-authored with Carver Mead), which became the standard text in courses around the world.

Conway excelled in physics and mathematics in high school, and began her college career as a physics major at the Massachusetts Institute of Technology (MIT). She took some time off from school before returning to Columbia University to complete her undergraduate and master's degrees in engineering. While at Columbia, her course project was a software system that impressed a visiting professor and led to a job at IBM. In 1969, she accepted a position with Memorex Corporation, where she headed a project to develop a processor for an inexpensive office computer. Memorex decided to drop its computer program and, in 1973, Conway joined Xerox Corporation on a project to superimpose an optical character recognition over a facsimile system. The prototype was a mammoth machine that filled a room, and Xerox dropped the project. She next worked on designing computer chips, which resulted

in the major accomplishment of simplifying computer chip design, and briefly taught a course on chip design at MIT. In 1983, she had the opportunity to work for the Defense Advisory Research Projects Agency (DARPA) in Washington, D.C., the agency that developed ARPAnet, an early version of the Internet. Part of her job was to oversee the preparation of an advanced computing program to secure funding from Congress. She moved to the University of Michigan in 1985 as associate dean of the College of Engineering, where she spent the remainder of her career and helped the university keep abreast of computer research and technology.

Conway is truly a pioneer in computer technology, as she has worked at the forefront of technologies such as artificial intelligence (AI), robotics, telecommunications, and personal computers. But she has an unusual personal story as well, in that she was born a male (Robert) and underwent gender reassignment surgery in 1968. She believes she was fired from IBM because of her surgery, and she did not speak publicly about her past as a man for many years, achieving worldwide recognition for her work as a woman computer scientist. She now maintains a website that tells her story and provides information on transgender and transsexual issues.

Conway is a fellow of the Institute for Electrical and Electronics Engineers, and has served on the editorial board of the Institute of Electrical and Electronics Engineers (IEEE) magazine *Spectrum*. She is or has been a member of the American Association for the Advancement of Science, the American Association for Artificial Intelligence, and the U.S. Air Force Scientific Advisory Board, and is a presidential appointee on the Board of Visitors of the U.S. Air Force Academy. She was elected to the National Academy of Engineering in 1989 and has received numerous awards, including the Wetherill Medal from the Franklin Institute (1985), the Meritorious Civilian Service Award given by the Secretary of Defense (1985), and the National Achievement Award of the Society of Women Engineers (1990).

Further Resources

University of Michigan. "Lynn Conway: Computer Scientist, Electrical Engineer, Inventor; Research Manager, Engineering Educator." <http://ai.eecs.umich.edu/people/conway/conway.html>.

Conwell, Esther Marly

b. 1922
Physicist

Education: B.A., physics, Brooklyn College, 1942; M.S., physics, University of Rochester, 1945; Ph.D., physics, University of Chicago, 1948

Professional Experience: instructor, physics, Brooklyn College, 1946–1951; technical staff, Bell Telephone Laboratories, 1951–1952; engineering specialist, Sylvania/General Telephone and Electronics Laboratory (GTE), 1952–1963, manager, physics department, 1963–1970; professor, Massachusetts Institute of Technology, 1971–1972; principal scientist, Xerox Laboratories, 1972–1980, research fellow, 1980–1998; professor, chemistry and physics, University of Rochester, 1998–

Concurrent Positions: visiting lecturer and researcher, University of Paris, 1962–1963; associate director, National Science Foundation Center for Photoinduced Charge Transfer, University of Rochester, New York, 1991–

Esther Conwell is a physicist who specializes in the study of solid-state materials, such as silicon, which are used to make transistors and semiconductors in the electronics and computer industries. She spent almost her entire career in industry, as head of research departments at both GTE and Xerox. She has published more than 100 papers in leading scientific journals, describing how semiconductors can be affected by subjecting the substances to outside perturbations like high electric fields. She is the author of an early work in the industry, *High-Field Transport in Semiconductors* (1967), which became a widely used text on the topic. She has also researched xerography, or photoconductors, in the use of copy machines.

Her father lived through the Depression and encouraged Conwell's education so that she would be able to support herself someday. Although she taught briefly at Brooklyn College, there were few academic positions for a woman physicist at the time she received her Ph.D., so she found her niche in industry research. She worked at the Bell Telephone Laboratories for one year, then moved to GTE, where she rose through the ranks to manager of the physics department. She spent another year teaching at the Massachusetts Institute of Technology (MIT) before accepting a position as principal scientist and then research fellow for Xerox. Since her retirement from Xerox, she has been on the chemistry faculty at the University of Rochester.

Conwell received the Society of Women Engineers achievement award (1960) and was elected to both the National Academy of Engineering (1980) and the National Academy of Sciences (1990). She has been elected a fellow of the American Physical Society and the American Academy of Arts and Sciences, and is a member of the Institute of Electrical and Electronics Engineers (IEEE). Her numerous awards and honors include the Achievement Award of the Society of Women Engineers (1960), being the first woman to receive the Thomas Edison Medal of the IEEE (1997), a Dreyfus Senior Scholar Mentor Award (2005), and the Susan B. Anthony Lifetime Achievement Award of the University of Rochester (2006); most recently, the American Chemical Society honored her with an Award for Encouraging Women into Careers in the Chemical Sciences

(2008). As part of her commitment to issues faced by women scientists, she was a founding member of the American Physical Society's Committee on Women in Physics (1971). In 2002, she was named by *Discover* magazine as one of the 50 most important female scientists. Her son, Lewis Rothberg, is also a physicist on the faculty at the University of Rochester, and the two have collaborated on research and articles for publication.

Further Resources

Byers, Nina and Gary A. Williams. 2006. *Out of the Shadows: Contributions of Twentieth-Century Women to Physics*. New York: Cambridge University Press.

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

University of Rochester. Faculty website. <http://www.chem.rochester.edu/faculty/faculty.php?name=conwell>.

Cordova, France Anne-Dominic

b. 1947

Astronomer, Astrophysicist

Education: B.A., Stanford University, 1969; Ph.D., physics, California Institute of Technology, 1979

Professional Experience: high school teacher, 1969–1971; research assistant, astrophysics, California Institute of Technology, 1975–1979, fellow, 1979; staff member and department group leader, astrophysics, Los Alamos National Laboratory, 1979–1989; professor and head, Department of Astronomy and Astrophysics, Pennsylvania State University, 1989–1993; chief scientist, National Aeronautics and Space Administration (NASA), 1993–1996; professor, physics and vice chancellor for research, University of California, Santa Barbara, 1996–2002; professor, astrobiology and chancellor, University of California, Riverside, 2002–2007; president, Purdue University, 2007–

France Cordova, an observational astronomer and high-energy astrophysicist, served as chief scientist at the National Aeronautics and Space Administration (NASA), a professor of physics and astrobiology, and a college president. Her research covers a wide range of subjects: observational and experimental astrophysics, multispectral research on x-ray and gamma-ray sources, ultraviolet spectroscopy of nearby binary stars, thermal emissions from neutron stars, and spaceborne instrumentation. As a chief scientist for NASA, she worked on the



Astronomer and astrophysicist France Anne-Dominic Cordova became president of Purdue University in 2007. (AP/Wide World Photos)

Mars *Pathfinder* Space Program and, although she left NASA before the *Pathfinder* reached Mars in 1997, NASA later awarded her its highest honor, the Distinguished Service Medal (2007). Cordova spent several years in California, improving funding for space and science research in the University of California system. In 2007, she became the first woman, and first Latina, to become president of Purdue University, coincidentally the alma mater of astronaut Neil Armstrong.

Cordova initially intended to study anthropology, but after college graduation began teaching high school physics and math. She became interested in cosmology and earned her Ph.D. in physics in 1979. She was employed at the Los Alamos National Laboratory, where she studied white dwarfs, neutron stars, and black holes, theorizing that white dwarfs should emit x-rays but at lower intensities than neutron stars. She looked at more than 200 white dwarf close binaries with x-ray satellites to prove this theory and, with colleagues, described mathematically the low-energy pulsations in these systems. She moved to Pennsylvania State University in 1989 as professor and head of the Department of Astronomy and Astrophysics, where her husband, Christian J. Foster, led a Ph.D. program in cognitive science and education.

Cordova has served on numerous prestigious committees, including the President's National Medal of Science Committee (1991–1993), the committee that selects the persons to receive the National Medal of Science, one of the top awards in the nation. She received a Distinguished Alumni Award from the California Institute of Technology (2007) and was named to Stanford University's Multicultural Hall of Fame (2008). She is a fellow of the American Academy of Arts and Sciences and the Association for Women in Science, and a member of the American Astronomical Society and the International Astronomical Union. In 1996, she appeared on a PBS television series about women minority scientists.

Further Resources

Purdue University. President's website. <http://www.purdue.edu/president/about/index.html>.

Cori, Gerty Theresa Radnitz

1896–1957

Biochemist

Education: M.D., German University of Prague, 1920

Professional Experience: assistant, Karolinen Children's Hospital, 1920–1922; assistant pathologist, Roswell Park Memorial Institute, 1922–1925, assistant biochemist, 1925–1931; researcher, medical school, Washington University, St. Louis, 1931–1947, professor, biochemistry, 1947–1957

Gerty Cori was a biochemist who was the first woman to receive a Nobel Prize in Physiology or Medicine, and the first American woman to win in any of the sciences. She won the Nobel Prize jointly with her husband, Carl F. Cori, in 1947 for their work on the effect of hormones on the rate of conversion of glycogen to glucose in the overall processes of the body's carbohydrate metabolism. Their discovery was termed the "Cori cycle," and their laboratory at Washington University in St. Louis became the focal point for all researchers interested in carbohydrate metabolism. Their research had implications for understanding diabetes and other metabolic diseases, and in later work they demonstrated that a human heritable disease can stem from a defect in an enzyme.

The couple met while they were both in medical school in Prague and immigrated to the United States when Carl received an appointment at Roswell Park Memorial Institute in Buffalo, New York. Gerty also received a staff appointment and, in addition to their regular duties, the two pursued their own research interests in normal carbohydrate metabolism and its regulation. They decided to leave Roswell and Carl was recruited by several universities, none of which would offer Gerty a faculty appointment. They finally found dual positions at Washington University, where Carl was chair of the department of pharmacology, and Gerty collaborated with her husband while receiving a token salary as a researcher for more than 15 years. Only after they were awarded the Nobel Prize did she receive a full professorial appointment.

Gerty was diagnosed with bone marrow disease in 1947, but she continued to work for another 10 years in spite of extreme pain. After receiving the Nobel Prize, she was elected to the National Academy of Sciences in 1948. She was also the 1948 recipient of the Garvan Medal of the American Chemical Society. In 2008, the U.S. Postal Service issued a stamp featuring Gerty Cori as part of an "American Scientists" series.

Further Resources

Opfell, Olga S. 1986. *The Lady Laureates: Women Who Have Won the Nobel Prize*. Metuchen, NJ: Scarecrow Press.

McGrayne, Sharon Bertsch. 1998. *Nobel Prize Women in Science: Their Lives, Struggles, and Momentous Discoveries*. Secaucus, NJ: Birch Lane Press.

“Dr. Gerty Theresa Radnitz Cori.” Changing the Face of Medicine: Celebrating America’s Women Physicians. National Library of Medicine. National Institutes of Health. <http://www.nlm.nih.gov/changingthefaceofmedicine/physicians/biography69.html>.

Cowings, Patricia Suzanne

b. 1948

Psychologist, Physiologist

Education: B.A., psychology, State University of New York at Stony Brook, 1970; M.A. and Ph.D., psychology, University of California, Davis, 1973

Professional Experience: postdoctoral associate, National Aeronautics and Space Administration (NASA)/Ames Research Center, 1973–1975; research specialist, San Jose State University Foundation, 1975–1977; research psychologist and principal investigator, NASA/Ames Research Center, 1977–

Concurrent Positions: adjunct associate professor, psychology, University of Nevada, Reno, 1987; adjunct assistant professor, psychiatry, University of California, Los Angeles, 1991–2001; acting assistant chief, Life Sciences Division, NASA/Ames, 1995; adjunct associate professor, biomedical engineering, University of Akron, Ohio, 1997–; adjunct assistant professor, medical/clinical psychology, F. Edward Hebert School of Medicine, Uniformed Services University of Health Sciences, Maryland, 1998–

Patricia Cowings is known for specialized work in psychophysiology, the study of the relationships among the mind, behavior, and bodily mechanisms, and, in particular, in studying the effects of zero gravity on astronauts. She worked to develop a treatment for the motion sickness commonly experienced by astronauts and pioneered the use of biofeedback and autogenic (or self-suggestion) training to help suppress the problem. The results of her research were first tested in space and found successful during the September 1992 Spacelab-J mission, an eight-day flight of the space shuttle *Endeavour*. Cowings replicated the conditions that cause motion sickness to record the physiological and psychological changes that occurred. The astronauts affectionately called her “the Baroness of Barf.” She teaches a subject to mentally evoke a sensation, like warmth in a limb or relaxation of muscles, to bring about desired physiological changes such as increased skin

temperature or relaxed muscles. In biofeedback, she teaches people to control as many as 20 physiological functions related to motion sickness, including heart rate, skin conductance, depth and rate of respiration, and flow of blood to the hands. During the first test in space, the astronauts had biofeedback units strapped to their wrists. Another area in which Cowings has worked is therapy to exercise the veins in the astronauts' legs to combat the effects of weightlessness. Her husband, William B. Tiscano, also works at NASA, and the two have co-authored several publications together.



NASA psychophysiologicalist Dr. Patricia Cowings. (NASA)

Cowings's work combines her early interests in both space science and psychology. After receiving her doctorate in psychology, she received a postdoctoral appointment at NASA's Ames Research Center and has remained there throughout most of her career. Her research for NASA has led to important breakthroughs for the comfort and health of astronauts, and her autogenic training exercise methods and system were patented in 1997. She has received numerous awards and honors, including the NASA Individual Achievement Award (1993), Black Engineer of the Year Award (1997), AMES Honor Award for Technology Development (1999), NASA Space Act Award for invention (2002), and National Women of Color Technology Award (2006). She is a member of the Society for Psychophysiological Research, American Association for the Advancement of Science, and New York Academy of Sciences.

Further Resources

Ehrhart-Morrison, Dorothy. 1997. *No Mountain High Enough: Secrets of Successful African American Women*. Berkeley, CA: Conari Press.

Kevles, Bettyann H. 2003. *Almost Heaven: The Story of Women in Space*. New York: Basic Books.

National Aeronautics and Space Administration. "Patricia Cowings." http://humansystems.arc.nasa.gov/groups/ACD/personnel_view.php?personnel_id=20.

Cox, Geraldine Anne (Vang)

b. 1944

Environmental Scientist, Biologist

Education: B.S., Drexel University, 1966, M.S., 1967, Ph.D., environmental science, 1970

Professional Experience: technical coordinator of environmental programs, Raytheon Company, 1970–1976; White House fellow, special assistant to secretary, U.S. Department of Labor, 1976–1977; environmental scientist, American Petroleum Institute, 1977–1979; vice president and technical director, Chemical Manufacturers Association, 1979–1991; vice president, Fluor Daniel, subsidiary of Fluor Corporation, 1991–1993; chair and chief executive officer, AMPOTECH, 1994–2000; independent consultant, 1996–; Disaster Assistance Employee, FEMA, U.S. Department of Homeland Security, 2004–

Concurrent Positions: adjunct associate professor, Graduate Environmental Program, Drexel University, 2002–

Geraldine Cox is an environmental scientist whose research focuses on water pollution, ecological damage assessment, and environmental health. She is known for her role in creating chemical industry policy guidelines for community emergencies following the accidental release of methyl isocyanate gas at a plant in Bhopal, India, late in 1984. At the time, she was vice president and technical director of the Chemical Manufacturers Association, a professional organization whose members represent 90% of the chemical companies in the United States. The explosion was devastating to the owner of the plant, Union Carbide Corporation, because of the contamination of the area around the plant and the adverse publicity about safety procedures at that location. In the United States, the Chemical Manufacturers Association's guidelines established the Community Awareness and Emergency Response (CAER), which led to the adoption of a federal and later an international standard drafted by the United States, both based on Cox's model.

Cox left the association in 1991 to join Fluor Daniel as a vice president, a position she held for two years before helping to found AMPOTECH, a company committed to using waste coal and other technologies to create low-pollution energy in developing countries. She has been an environmental impact consultant and analyst for both government and trade organizations such as the Environmental Protection Agency, U.S. Department of Justice, and the chemical technologies firm EUROTECH, and has been a participant in numerous workshops and committees of the National Research Council of the National Academy of Sciences. She has held many significant committee assignments, such as founder and chair of the Marine Water Quality

Committee, member of the Transportation Advisory Committee of the U.S. Coast Guard (from whom she received a Meritorious Service Medal, the highest civilian award, in 1992), and member of the Engineering Affairs Council of the Association of American Engineering Societies. She has received the Achievement Award of the Society of Women Engineers (1984) and is a member of the American Society for Testing and Materials, Water Pollution Control Federation, American Chemical Society, American National Standards Institute, and Society of Women Engineers.

Cox, Gertrude Mary

1900–1978

Mathematician, Statistician

Education: B.S., mathematics, Iowa State University, 1929; M.S., statistics, 1931; graduate student, psychological statistics, University of California, Berkeley, 1931–1933

Professional Experience: research assistant to assistant professor, statistical laboratory, Iowa State University, 1933–1940; professor, experimental statistics, North Carolina State College, 1940–1944, head, Institute of Statistics, 1944–1949, department of biostatistics, 1949–1960; head, Research Triangle Institute, statistics research division, 1960–1965; independent consultant

Gertrude Cox was the prominent American woman statistician of her time and is remembered by many as the “First Lady of Statistics.” She founded the department of experimental statistics in the School of Agriculture and was head of the Institute of Statistics at North Carolina State College. Perhaps her greatest legacy was as an administrator, for Cox was committed to promoting statistics research and teaching at other institutions throughout the South, helping to establish programs at the University of North Carolina, Chapel Hill and the Research Triangle Institute, which combined and drew on the research of the three campuses at North Carolina State College, the University of North Carolina, and Duke University. Even after her formal retirement in 1965, she traveled to Egypt, where she spent a year helping establish an Institute of Statistics at the University of Cairo. Cox’s specialty was the design of experiments, and she enthusiastically used each new generation of computers as they became available. Under her leadership, North Carolina State College was one of the first colleges to use IBM computers and therefore to develop some of the most powerful statistical software programs. She published *Experimental Designs* (1950, co-authored with William Cochran), which became a popular and widely used textbook.

After graduating high school, Cox began training to become a deaconess in the Methodist Episcopal Church. She enrolled at Iowa State to obtain a degree in social

science, but switched to mathematics for her bachelor's degree in 1929 and, in 1931, received the first master's degree in statistics from Iowa's mathematics department. She studied psychological statistics at Berkeley for two years before returning to Iowa State to assist in establishing the new Statistical Laboratory. Although she never completed the requirements for the Ph.D., she was appointed to the faculty at Iowa State in 1939. When her Iowa advisor was asked by North Carolina State College for faculty recommendations, he sent a list of male graduates for consideration, but then added a note: "Of course if you would consider a woman for this position I would recommend Gertrude Cox of my staff." Cox was hired in 1940 as head of the newly created department of experimental statistics at North Carolina State College, the first female head of any department at that institution. She obtained sizable grants from the Rockefeller and Ford Foundations for her program in statistics and in 1945 organized and became director of the Institute of Statistics, which combined the teaching of statistics at the University of North Carolina and at North Carolina State College. Even after her retirement from the Research Triangle Institute in 1965, Cox remained active as a consultant for government agencies and research groups.

Cox was the first woman elected to the International Statistical Institute (1949), and she served as president of the American Statistical Association (1956). She was one of the founders and also president of the Biometric Society (1969), and was editor (1945–1955) of the Society's *Biometrics Bulletin*. She was a fellow of the Institute of Mathematical Statistics and the Royal Statistical Society of England, and was elected to the National Academy of Sciences in 1975. Her contribution to North Carolina State College (now North Carolina State University) has been honored with both a building and a scholarship in her name, and, in 1986, the Caucus of Women in Statistics also established a Gertrude M. Cox Scholarship fund in her name.

Further Resources

American Statistical Association. Statisticians in History. <http://www.amstat.org/about/statisticiansinhistory/index.cfm?fuseaction=biosinfo&BioID=2>.

Crane, Kathleen

b. 1951

Oceanographer

Education: B.S., Oregon State University, 1973; Ph.D., oceanography, Scripps Institution of Oceanography, 1977

Professional Experience: postdoctoral fellow, Woods Hole Oceanographic Institution, 1977–1979; research scientist, Lamont-Doherty Geological Observatory,

1979–1993; professor, ocean and earth sciences, Hunter College, City University of New York, 1985–2002; program manager, Arctic Research Office, National Oceanic and Atmospheric Administration (NOAA), 2002–

Concurrent Positions: director, Arctic Environmental Security Geographic Information System, Naval Research Laboratory, 1993–1998

Kathleen Crane is an oceanographer, marine geologist, and ecologist who focuses on the Arctic region. She is program manager of the Arctic Research Office of NOAA, where she coordinates missions related to Arctic marine ecosystems and climate change and has been mission coordinator for two major expeditions (2004 and 2009) of the Russian-American Long-term Census of the Arctic (RUSALCA). Crane received a doctorate in oceanography from the Scripps Institution of Oceanography in San Diego, California, where she studied geophysics and underwater thermal vents in the Galapagos. She studied mid-ocean ridges as a postdoctoral researcher at Woods Hole Oceanographic Institution in Massachusetts, and then began an affiliation with the Lamont-Doherty Earth Observatory in New York. She was a director of an Arctic environmental research program at the Naval Research Laboratory and taught for many years at Hunter College in New York.

Having originally studied waters and marine geology in the southern hemisphere, in the 1990s, Crane became interested in Arctic research. Her professional and personal lives came together after adopting her daughter from Siberia in 1996, and in 2002, she left academia to join NOAA as part of a U.S.–Russian collaboration on Arctic research. Crane has been an invited lecturer and visiting scientist at numerous institutions throughout the United States and Europe, including the University of California, Santa Barbara; the University of Hawaii; the University of Oslo, Norway; and the University of Paris, France. She has coordinated and been chief scientist of more than 18 international ocean expeditions as well. In 2003, she published an autobiography, *Sea Legs: Tales of a Woman Oceanographer*.

Further Resources

Delaney, Peggy, ed. 2005. “Autobiographical Sketches of Women in Oceanography.” *Oceanography* 18(1): 65–246. (March 2005). The Oceanography Society. http://www.tos.org/oceanography/issues/issue_archive/issue_pdfs/18_1/18.1_sketches.pdf.

Crosby, Elizabeth Caroline

1888–1983

Neuroanatomist

Education: B.S., Adrian College, 1910; M.S., University of Chicago, 1912, Ph.D., 1915

Professional Experience: principal and school superintendent, 1915–1920; instructor, anatomy, University of Michigan Medical School, 1920–1926, assistant to associate professor, anatomy, 1926–1936, professor, anatomy and consulting neurosurgeon, 1936–1960; professor emeritus, anatomy, University of Alabama, Birmingham, 1963–1983

Elizabeth Crosby was recognized as one of the leading anatomists of her time. Her fields of research were neurobiology and neuroanatomy, or the anatomy of the brain, with a special focus on the brains of vertebrates. After completing her doctorate at the University of Chicago, she worked as a public school administrator in Michigan before receiving an appointment as instructor at the University of Michigan. Over the course of her long career as a medical researcher, she co-authored several textbooks for neurosurgeons: *A Laboratory Outline of Neurology* (1918), *The Comparative Anatomy of the Nervous System of Vertebrates, Including Man* (1936), *The Correlative Anatomy of the Nervous System* (1962), and *The Comparative Correlative Neuroanatomy of the Vertebrate Telencephalon* (1982). She held many distinguished lectureships at the University of Pittsburgh, Yale University, Mayo Clinic, Tulane University, and Emory University. After her retirement, she was an emeritus professor at both the University of Michigan and the University of Alabama, Birmingham, where she continued to direct the research of a new generation of neuroanatomists. She has been inducted into both the Michigan and Alabama Women's Hall of Fame.

At the University of Michigan, Crosby rose steadily through the ranks to become the first woman to reach full professor at the Medical School. This was a significant accomplishment because she did not have a medical degree. Toward the end of her career, in 1958, she received an honorary M.D. from the University of Groningen in The Netherlands. She also received the Galen Award in 1956 for preclinical medical teaching and in 1979 was awarded the National Medal of Science under President Jimmy Carter. She received several awards in recognition for her studies on the comparative neurology of vertebrates and ultimately received nine honorary doctoral degrees, including from Smith College (1968), Woman's Medical College of Pennsylvania (1968), and the University of Michigan (1970).

Further Resources

Alabama Women's Hall of Fame. 2000. "Elizabeth Caroline Crosby (1888–1983)." <http://www.awhf.org/crosby.html>.

D

Daly, Marie Maynard

1921–2003

Biochemist

Education: B.S., Queens College, 1942; M.S., New York University, 1943; Ph.D., chemistry, Columbia University, 1948

Professional Experience: instructor, physical sciences, Howard University, 1947–1948; visiting investigator and assistant, general physiology, Rockefeller Institute, 1951–1955; associate, biochemistry, Goldwater Memorial Hospital, Columbia University, 1955–1959; assistant professor, biochemistry, Columbia University, 1960–1971; associate professor, biochemistry and medicine, Albert Einstein College of Medicine, Yeshiva University, 1971–1986

Concurrent Positions: American Cancer Society fellow, Rockefeller Institute, 1948–1951; established investigator, American Heart Association, 1958–1963; career scientist, Health Research Council of New York, 1962–1972; Commission on Science and Technology, City of New York, 1986–1989

Marie Daly was the first African American woman to receive a doctorate in chemistry, and she is known for her research on the chemistry of the cell nucleus. She taught at Howard University for one year while she sought an American Cancer Society fellowship to conduct research at Rockefeller Institute. At the Institute, she examined the ways in which proteins are constructed within the cells of the body, in particular the cell nucleus. In 1952, James Watson and Francis Crick described the structure of DNA, the spiral molecules that carry the genetic code of every living thing. Daly was fortunate that this breakthrough led to an immediate increase in the scientific study of the chemistry of the cell nucleus. When her research team moved to Columbia University, they undertook a long series of studies related to the underlying causes of heart attacks. She focused on the blockage of arteries that supply oxygen and nutrition to the heart muscle and discovered that cholesterol was part of the problem. She studied the effects of sugar and other dietary products on the health of the arteries. Daly also did pioneering work on the effects of cigarette smoke on the functioning of the lungs. She continued this project when the team moved to Albert Einstein College of Medicine, and she also

taught courses in biochemistry to medical students. She focused her research on the breakdown of the circulatory system caused either by advanced age or by hypertension. She also studied the biochemical aspects of kidney function.

Daly was a fellow of the American Association for the Advancement of Science, the New York Academy of Sciences, and the American Heart Association. She was a member of the American Chemical Society and the American Society of Biological Chemists, and sat on the board of governors for the New York Academy of Science. She was also committed to increasing the presence of minorities in the sciences, was a member of the National Association for the Advancement of Colored People, and started a scholarship fund at Queens College in her father's memory to support minority students in physics and chemistry.

Darden, Christine V. Mann

b. 1942

Aeronautical Engineer

Education: B.S., mathematics, Hampton Institute, 1962; M.S., applied mathematics, Virginia State College, 1967; D.Sc., engineering, George Washington University, 1983

Professional Experience: high school teacher, 1962–1965; research assistant, physics, Virginia State College, 1965–1966, instructor, mathematics, 1966–1967; data analyst, National Aeronautics and Space Administration (NASA)/Langley Research Center, 1967–1973; aerospace engineer, NASA, 1973–1989; leader, Sonic Boom Team, NASA, 1989–1994; deputy program manager, high speed research, NASA/Langley Research Center, 1994–1999; senior project engineer, Advanced Vehicles Division, 1999–2001; director, Aeroperforming Program, 2002–2003; director, Office of Communication and Education, NASA, 2004–2007

Concurrent Positions: management trainee, Senior Executive Career Development Fellowship, Simmons College, Boston, 1994–1995

Christine Darden is recognized as an expert on the effects of sonic booms or shock waves and the creator of a computer software program that is used across the United States for simulating a sonic boom in a wind tunnel. Other engineers at NASA were building models of aircraft to test them in wind tunnels, but Darden's computer program simulated the sound wave with the same results. The computer program was less expensive and more efficient, and Darden was promoted to leader of the Sonic Boom Team. One area of her research was to redesign the supersonic transport (SST) airplane to change the shape of the wing and to blunt the nose to minimize the sonic boom. Later, the federal government decided not

to invest in the SST because of its expense, but the NASA project continued because military aircraft sometimes reach supersonic speeds as they fly across populated areas. U.S. federal regulations specify that the Concorde, built by the French and the British, cannot reach supersonic speeds in populated areas, so those planes do not fly in the United States because of the financial considerations of flying at lower speeds. Darden also led research into the environmental impact of supersonic flights, such as the effect on the ozone layer of the atmosphere.

Darden's early interest in mathematics led her to teach high school math and then to studying math and physics in graduate school. She studied mathematics at the historically black Hampton Institute and, at Virginia State College, secured a research assistantship in the physics department on a project analyzing air quality and determining the presence of specific kinds of pollutants. After receiving her master's degree, she obtained a job at NASA as a data analyst doing very routine calculations for the engineers. As the research became more computer-oriented, she wrote software programs for the engineers and started taking doctorate-level classes in both mathematics and engineering science. After successfully completing a difficult fluid mechanics course, she enrolled in the engineering program at George Washington University, where she received her Ph.D. in 1983. At the time, there were few black men and very few women of any race in engineering.

Darden is a member of the National Technical Association (NTA) and the American Institute of Aeronautics and Astronautics. Her awards and honors include the A. T. Weathers Technical Achievement Award of the NTA (1985), the Candace Award for Science and Technology of the National Coalition of 100 Black Women (1987), and being named Black Engineer of the Year in Government by the Mobil Oil Council of Engineering Deans (1988). She also received NASA Certificates of Outstanding Performance from the Langley Research Center in 1989, 1991, and 1992. Darden is active in her church community and was ordained as an elder in the Presbyterian church in 1980.

Further Resources

Warren, Wini. 1999. *Black Women Scientists in the United States*. Bloomington: Indiana University Press.

Daubechies, Ingrid

b. 1954

Mathematician

Education: B.S., physics, Vrije Universiteit Brussel, Belgium, 1975, Ph.D., physics, 1980



Mathematician Ingrid Daubechies. (Princeton University, Office of Communications, Brian Wilson)

Professional Experience: research assistant, theoretical physics, Vrije Universiteit Brussel, Belgium, 1975–1984, research professor, 1984–1987; technical staff member, Mathematics Research Center, AT&T Bell Laboratories, 1987–1994; professor, mathematics and Program in Applied and Computational Mathematics, Princeton University, 1994–2004, director, Program in Applied and Computational Mathematics, 1997–2001, William R. Kenan, Jr., Professor, Princeton University, 2004–

Concurrent Positions: visiting professor, University of Michigan, 1990; professor, mathematics, Rutgers University, 1991–1993

Ingrid Daubechies is an applied mathematician and theoretical physicist who specializes in time-frequency

analysis and the construction of wavelets, which are used for data compression in applications such as digital image processing. Daubechies was born in Belgium and received her doctorate in physics from Vrije Universiteit (Free University) Brussels in 1980. She remained on as a researcher and faculty member in theoretical physics at Free University until relocating to the United States for a position with AT&T Bell Laboratories in 1987. She joined the faculty of mathematics at Princeton University in 1994 and served as director of the Program in Applied and Computational Mathematics for four years.

Daubechies was elected to the National Academy of Sciences in 1998 and is a fellow of the American Academy of Arts and Sciences and the Institute of Electrical and Electronics Engineers (IEEE), a Foreign Member of the Royal Netherlands Academy of Arts and Sciences, and a member of the American Mathematical Society, Mathematical Association of America, and Society for Industrial and Applied Mathematics. She was named the Josiah Willard Gibbs Lecturer of the American Mathematical Society (2005) and was the prestigious Emmy Noether Lecturer (2006). She has received numerous other honors and awards for her work, including a five-year MacArthur Foundation “genius” grant (1992–1997) and the

American Mathematical Society Steele Prize for Exposition (1994) for her book *Ten Lectures on Wavelets*. She also received the Louis Empain Prize for Physics for a young Belgian scientist (1984), the American Mathematical Society Ruth Lyttle Satter Prize in Mathematics (1997), the International Society for Optical Engineering Recognition of Outstanding Achievement (1998), the IEEE Information Theory Society Golden Jubilee Award for Technological Innovation (1998), the Eduard Rhein Foundation Basic Research Award (2000), the Gold Medal (Gouden Penning) of the Flemish Royal Academy of Arts and Sciences, Belgium (2005), and the Pioneer Prize from the International Council for Industrial and Applied Mathematics (2008; co-recipient). In 2000 she was the first woman to receive the National Academy of Sciences Award in Mathematics. She has received honorary doctorates from universities in Belgium, Switzerland, France, and Italy.

Further Resources

Case, Bettye Anne and Anne Leggett, eds. 2005. *Complexities: Women in Mathematics*. Princeton, NJ: Princeton University Press.

Agnes Scott College. "Ingrid Daubechies." Biographies of Women Mathematicians. <http://www.agnesscott.edu/lriddle/women/daub.htm>.

Princeton University. Faculty website. <http://www.pacm.princeton.edu/~ingrid/>.

Davis, Margaret Bryan

b. 1931

Paleoecologist, Palynologist, Ecologist

Education: B.A., Radcliffe College, 1953; Ph.D., biology, Harvard University, 1957

Professional Experience: fellow, biology, Harvard University, 1957–1958; fellow, geoscience, California Institute of Technology, 1959–1960; research fellow, zoology, Yale University, 1960–1961; research associate, botany, University of Michigan, 1961–1964, associate research biologist, Great Lakes Research Division, 1964–1970, associate professor, zoology, 1966–1970, research biologist, Great Lakes Research Division and professor, zoology, 1970–1973; professor, biology, Yale University, 1973–1976; professor, ecology and head, Department of Ecology and Behavioral Biology, University of Minnesota, 1976–1981, professor, 1981–1983, Regents Professor, Ecology, Evolution, and Behavior, 1983–



Paleoecologist, palynologist and ecologist, Margaret Bryan Davis. (Courtesy of the University of Minnesota)

Margaret Davis is a distinguished paleoecologist who is renowned for her analysis of ancient pollen to determine trends in plant growth and migration. Palynology is the study of pollen from ancient plants, and as an undergraduate at Radcliffe, she took a course on paleobotany and became intrigued by the vegetational history of the late Quaternary period, some 10,000 years ago. She believed that the best method to understand and interpret the history of ancient plant life is to understand the physiology and ecology of flora (or plants) rather than just the stratigraphic interpretation of pollen records. She received a Fulbright fellowship to study in Greenland, where she recorded plant pollen deposited during the interglacial period.

Davis later focused on geology and studied the relationship between pollen in lake sediments and vegetation composition in order to enhance the precision of pollen records for describing past vegetation. In 1963, she attracted international attention with a paper published in the *American Journal of Science* on her theory of pollen analysis. Davis also compiled maps for eastern North America depicting the migration of various species of trees during the past 14,000 years. Her maps indicate that the temperate-forest trees moved at different rates and in different directions. Her work has implications for the current debate over global warming, and she predicted in 1989 that, in the next 100 years, sugar maple trees will disappear across the southern edge of their current range in the middle of the country and will shift eastward in Minnesota. Beech trees will disappear from the United States except in northernmost Maine, and scattered blocks of growth will open up in Canada.

Davis was elected to membership in the National Academy of Sciences in 1982. She has also served on numerous committees, such as on the International Union of Quaternary Research of the National Academy of Sciences and the National Research Council (1966–), as a delegate of the National Academy of Sciences to the International Union of Quaternary Research Congress (1969, 1973, 1977, and 1982), and as a member of the advisory panel for geological records of global changes of the National Science Foundation (1981–). She is a fellow of the

Geological Society of America and of the American Association for the Advancement of Science. She is a member of the American Quaternary Association (president, 1978–1980), American Society of Limnology and Oceanography, Ecological Society of America (president, 1987–1988), and International Society for Vegetative Science. In 1993, she was awarded the Nevada Medal for “unlocking the history of environmental change and using it to understand present and future shifts in plant and animal communities.”

Further Resources

University of Minnesota. Faculty website. <http://www.cbs.umn.edu/eeb/faculty/DavisMargaret/>.

Davis, Ruth Margaret

b. 1928

Computer Scientist, Mathematician

Education: B.A., American University, 1950; M.A., University of Maryland, 1952, Ph.D., mathematics, 1955

Professional Experience: mathematician, U.S. National Bureau of Standards, 1950; research associate, Institute of Fluid Dynamics and Applied Mathematics, University of Maryland, 1952–1955; mathematician, David Taylor Model Basin, 1955–1958, head, Operations Research Division, 1957–1961; staff assistant, Office of the Special Assistant for Intelligence and Reconnaissance, Office of the Director of Defense Research and Engineering, U.S. Department of Defense, 1961–1967; associate director, Research and Development, National Library of Medicine, 1967–1968; director, Lister Hill National Center for Biomedical Communications, 1968–1970; director, Center for Computer Science and Technology, National Bureau of Standards, 1970–1972; director, Institute for Computer Science and Technology, 1972–1977; Deputy to Secretary of Defense for Research and Engineering, U.S. Department of Defense, 1977–1979; Assistant Secretary for Energy, U.S. Department of Energy, 1979–1981; founder, president, and CEO, Pymatuning Group, Inc., 1981–

Concurrent Positions: lecturer, University of Maryland, 1955–1956 and American University, 1957–1958; consultant, Office of Naval Research, 1957–1958; adjunct professor, engineering, University of Pittsburgh, 1981–

Ruth Davis is a pioneer in computer science who is credited with programming three of the first digital computers—SEAC, ORDVAC, and UNIVAC I. She is also

responsible for securing worldwide acceptance of a data encryption standard, enabling the United States to become a leader in robotics, and implementing a medical literature retrieval system and a satellite hookup to link the sick in remote Alaska with doctors in the outside world. Her first two jobs involved working for the U.S. Navy in developing the first computer programs for nuclear reactor design. After receiving her undergraduate degree, she worked for the National Bureau of Standards before returning to school to complete her master's degree. Davis has since had a productive career working primarily in U.S. government positions before establishing her own company.

Davis was later employed in the Office of the Director of Defense Research and Engineering, and then did pioneering research in information technology and indexing of medical articles for the National Library of Medicine between 1967 and 1970. Davis was appointed director of the Institute of Computer Science and Technology at the National Bureau of Standards, where she developed standards for data encryption, or coding of data for computing. Working for the Department of Defense, she was involved in early work on robotics between 1977 and 1979. She concluded her government work as assistant secretary of resource applications for the Department of Energy. In 1981, she founded her own consulting firm, Pymatuning Group, Inc., in Virginia.

Davis was the second woman to receive the "Man of the Year" award from the Data Processing Management Association (1966)—the first was the computer pioneer **Grace Murray Hopper**. Davis was elected to membership in the National Academy of Engineering in 1976. She has been a member of the board of directors of several companies, and received the Gold Medal of the Department of Commerce (1972), the Rockefeller Public Service Award for Professional Accomplishment and Leadership (1973), the National Civil Service League Award (1976), and the Ada Augusta Lovelace Award in Computer Science (1984). She is a fellow of the American Association for the Advancement of Science, American Institute of Aeronautics and Astronautics, and Society for Information Display. She is a member of the American Mathematical Society, Mathematical Association of America, Council on Library Resources, and National Academy of Public Administration.

DeFries, Ruth

b. 1957

Environmental Geographer

Education: B.A., earth sciences, Washington University, 1976; Ph.D., geography and environmental engineering, Johns Hopkins University, 1980

Professional Experience: hydrologist, U.S. Geological Survey (USGS), 1979–1980; research associate, Environmental Science and Engineering Group, Indian Institute of Technology, Bombay, India, 1981–1983; senior project officer, Committee on Global Change, National Research Council, Washington, D.C., 1983–1992; associate research scientist, geography, University of Maryland, College Park, 1992–1999, associate professor, geography and Earth System Science Center, 1999–2005, professor, 2005–2008; Denning Professor of Sustainable Development, Department of Ecology, Evolution, and Environmental Biology, Columbia University, 2008–

Concurrent Positions: visiting scientist, Carnegie Institution, Department of Plant Biology, Palo Alto, California, 1998

Ruth DeFries is an environmental geographer whose research focuses on how human activities impact the Earth's landscape, ecosystems, and biodiversity, and on the habitability of the Earth. She has written dozens of papers and book chapters on topics related to the environmental consequences of human land use, agricultural food production, urbanization, and carbon emissions, including habitat loss, deforestation, and climate change. She has used satellite images to make global scientific observations that can impact policy decisions. DeFries studied earth sciences as an undergraduate and received her doctorate in geography and environmental engineering from Johns Hopkins University in 1980. She spent two years at the Indian Institute of Technology in Bombay and worked for the U.S. National Research Council before joining the faculty at the University of Maryland in 1992. She held joint appointments in geography and the Earth System Science Interdisciplinary Center at the University of Maryland until 2008, and moved to Columbia University as professor of ecology, evolution, and environmental biology.

DeFries has been a member of several government advisory boards, including the National Aeronautics and Space Administration (NASA) Strategic Planning Committee for Terrestrial Ecology Program (since 2001), the NASA Science Team for Land Use and Land Cover Change (since 1996), the Committee on Geography, Board on Earth Sciences and Resources, for the National Research Council (2001–2003), the Scientific Advisory Board of the National Center for Ecological Analysis and Synthesis (2001–2004), and a member of the International Satellite Land Surface Climatology Project (since 1999). She is also a fellow of the Aldo Leopold Leadership Program of the Ecological Society of America.

DeFries was elected to the National Academy of Sciences in 2006. She is the recipient of a Performance Award of the National Research Council Commission on Geosciences, Environment, and Resources (1990), and in 2007 received a prestigious MacArthur “genius grant,” a five-year \$500,000 fellowship.

Further Resources

University of Maryland. Faculty website. <http://www.geog.umd.edu/people/DeFries.html>.

Columbia University. Faculty website. <http://www.columbia.edu/~rd2402/>.

De Laguna, Frederica Annis

1906–2004

Archaeologist, Anthropologist

Education: B.A., Bryn Mawr College, 1927; Ph.D., anthropology, Columbia University, 1933

Professional Experience: assistant and research associate, American section, University of Pennsylvania Museum, 1931–1935; associate soil conservationist, Pima Reservation, U.S. Department of Agriculture, 1935–1936; lecturer, Bryn Mawr College, 1938–1941, assistant professor to professor, 1941–1975

Concurrent Positions: Lieutenant Commander, U.S. Naval Reserve, 1942–1945

Frederica de Laguna was an archaeologist and anthropologist who led the first survey of the Pacific Eskimo cultures. Both of her parents were philosophy teachers at Bryn Mawr, where she received her undergraduate degree. She went on to study under prominent pioneer of modern anthropology Franz Boas at Columbia University, who encouraged her to study Arctic cultures. De Laguna received a European study fellowship from Bryn Mawr, studying in England and France before joining a six-month-long Danish expedition to Greenland in 1929 as an assistant in Eskimo archaeology, the first archaeological excavation of Greenland. De Laguna was part of the team that discovered a previously unknown Norse culture, the Inugsuk. She published *The Archaeology of Cook Inlet, Alaska* in 1934; it was deemed still relevant and reprinted more than 40 years later by the Alaska Historical Society. Among her other works is her three-volume masterpiece, *Under Mount Saint Elias: The History and Culture of the Yakutat Tlingit* (1972), also the subject of a 1997 documentary film, *Reunion Under Mount Saint Elias*. She later published a memoir of her first expedition, *Voyage to Greenland* (1977).

De Laguna never married and, feeling she had to choose between her work and having a family, devoted herself to her career. Throughout the 1930s, she led anthropological expeditions to Alaska and the Yukon, primarily for the University of Pennsylvania Museum, as a research associate and expert on Eskimo and Paleolithic art. She completed her Ph.D. at Columbia in 1933 and joined the faculty of Bryn Mawr College in 1938, where she established the Anthropology Department

and spent the remainder of her career. She rose through the ranks to full professor and secured funding for her work through grants from the Rockefeller Foundation, the Viking Fund, Inc., and the Danish government, among other sources. She served as a lieutenant commander in the U.S. Naval Reserve from 1942 to 1945. Her experience as an American in the Arctic region was invaluable during World War II, since most exploration had been conducted by the Danes and Norwegians. When Greenland and Alaska became strategic points in protecting mainland North America, her data and observations were used by the American and Canadian armed forces.

She was one of the first fellows of the Arctic Institute of North America, served as president of the American Anthropological Association (1967), and was elected to membership in the National Academy of Sciences (NAS) in 1975, the same year as **Margaret Mead**. De Laguna and Mead were among the first generation of women to engage in professional field archaeology and were the first women anthropologists appointed to the NAS. When the federal government passed the Native American Graves Protection and Repatriation Act (1990), de Laguna was among those who saw the legislation, intended to protect burial sites and the rights of ancestors to cultural artifacts and human remains, as a setback for science. De Laguna also published mystery novels with anthropological themes.

Further Resources

Bryn Mawr Now. "Founder of BMC Anthropology Department Dies at 98." (21 October 2004). <http://www.brynmawr.edu/news/2004-10-21/delaguna.shtml>.

Gacs, Ute et al. 1988. *Women Anthropologists: Selected Biographies*. Westport, CT: Greenwood Press.

Delgado, Jane L.

b. 1953

Psychologist

Education: B.A., State University of New York at New Paltz, 1973; M.A., psychology, New York University, 1975; M.S., urban policy and sciences, W. Averell Harriman School, 1981; Ph.D., psychology, State University of New York at Stony Brook, 1981

Professional Experience: clinical psychologist and children's talent coordinator, Children's Television Workshop, New York, 1973–1975; research assistant, State University of New York at Stony Brook, 1975–1979; staff member, Board of Co-operative Educational Services, Westbury, NY, 1977–1979; social science analyst,



Psychologist Jane L. Delgado has been president and chief executive officer of the National Alliance for Hispanic Health since 1985. (AP/Wide World Photos)

U.S. Department of Health and Human Services, 1979–1983, health policy advisor, 1983–1985; president and CEO, National Alliance for Hispanic Health, 1985–

Concurrent Positions: psychologist, private practice, 1979–

Jane Delgado is the president and chief executive officer of the only national organization that focuses on the improvement of health and human services for the nation's Hispanic population. The National Coalition of Hispanic Health and Human Services Organizations (now known as the National Alliance for Hispanic Health) was founded in 1985. Delgado oversaw the first national outreach program to educate and inform Hispanics about AIDS and brought women's health and environ-

mental health issues to the forefront of the organization. She is often called upon by Congress to provide the latest health statistics on Hispanics. In conjunction with the National Hispanic Women's Health Initiative, she published the first comprehensive health book by and about Latinas, *¡Salud! A Latina's Guide to Total Health—Body, Mind, and Spirit* (1997, rev. ed. 2002), available in both English and Spanish.

Delgado's family emigrated from Cuba to New York when she was just two years old. Although she had little knowledge of English when she entered kindergarten, she learned quickly and accelerated her studies, graduating from college by age 19. She began a master's degree program at New York University in social and personality psychology, and financed her studies by working as the children's talent coordinator for the television show *Sesame Street*. In this position, she developed a test to determine which children had good television personalities and initiated a movement to include handicapped children on the show. While in graduate school, she also worked as an instructor and consultant providing psychological and educational services for bilingual children, their parents, teachers, and school officials. She directed a three-year study focusing on language development as a predictor of

learning disabilities in children, simultaneously earning a doctorate in clinical psychology and a master's degree in urban policy and sciences.

Delgado went on to a position with the U.S. Department of Health and Human Services, where she managed projects concerning Hispanics, black colleges, and undocumented workers, and gained experience advising on health policy issues and dealing with officials at the federal, state, and local levels. She brought this experience to her later position as president of the National Alliance for Hispanic Health, a group founded by health professionals concerned about the healthcare issues, costs, and insurance needs of more than 45 million Hispanic Americans in the United States and Puerto Rico. Delgado has also served as advisor for numerous committees and community organizations, especially related to patient and consumer rights and safety. She was a member of the National Advisory Council for Mrs. Rosalyn Carter's Task Force on Mental Health, Robert Wood Johnson's National Advisory Committee on Hospice and Palliative Care, and the Environmental Protection Agency's Clean Air Act Advisory Council. She has received many awards and honors, including the Surgeon General's Award (1992), the Community Leadership Award of the Puerto Rican Family Institute (1996), and the Florence Kelley Consumer Leadership Award of the National Consumer League (2003).

Further Resources

National Alliance for Hispanic Health. <http://www.hispanichealth.org/>.

Delmer, Deborah

b. 1941

Plant Biologist

Education: B.A., bacteriology, Indiana University, 1963; Ph.D., cellular biology, University of California, San Diego, 1968

Professional Experience: postdoctoral fellow, University of California, San Diego, and University of Colorado, Boulder, 1968–1974; assistant to associate professor, Plant Research Laboratory, Michigan State University, 1974–1982; principal scientist, ARCO Plant Cell Research Institute, California, 1982–1986; professor, Hebrew University of Jerusalem, 1987–1997; professor, plant biology, University of California, Davis, 1997–2001; Associate Director for Food Security,

Rockefeller Foundation, New York City, 2002–2007; program director, BREAD, 2009–

Deborah Delmer is a plant biologist and biochemist whose research has been applied to agricultural and crop improvement related to international development. She was a science and policy advisor on food security at the Rockefeller Foundation, where she researched and advised on issues facing African farmers, such as poor soil quality, drought, pests, and plant diseases, and supported crop improvement initiatives specific to the developing world. Before joining the Rockefeller Foundation and working on grant and policy issues in global agriculture, she had a long career in research and academia and taught at Michigan State University, Hebrew University in Jerusalem, and the University of California, Davis. Her primary research was in cellular biology and plant biochemistry.

Delmer studied microbiology and bacteriology as an undergraduate at Indiana University and went on to graduate study in marine biology at Scripps Institution of Oceanography in California. She decided against marine biology and ocean travel after becoming seasick and switched to the biology program at the University of California, San Diego. She worked with a professor on a plant tissue culture project and became interested in plant biochemistry, receiving her Ph.D. in cellular biology in 1968. She held postdoctoral fellowships at UCSD and at the University of Colorado, Boulder before joining the faculty at Michigan State University's Plant Research Laboratory in 1974, where her research focused on how plants synthesize cellulose. She began working on a project in developing world agriculture that resulted in a major move to Jerusalem in 1987 to accept a position at Hebrew University. She spent 10 years in Jerusalem before returning to the United States and a position at the University of California, Davis. She left academia to join the Rockefeller Foundation. She retired from her Rockefeller position in 2007 and continues to consult on issues related to developing world agriculture, including as program director for BREAD (Basic Research to Enable Agricultural Development), a project funded by the National Science Foundation and the Bill & Melinda Gates Foundation to support small farmers in the developing world.

Delmer was elected to the National Academy of Sciences in 2004. She is a member of the American Society of Plant Biologists (president, 1999–2000). She received the Anselme Payen Award from the American Chemical Society (2004).

Further Resources

Zagorski, Nick. 2005. "Profile of Deborah P. Delmer." *Proceedings of the National Academy of Sciences*. 102(44): 15736–15738. (1 November 2005). <http://www.pnas.org/cgi/content/full/102/44/15736>.

De Planque, E. Gail

b. 1945

Physicist

Education: B.A., mathematics, Immaculata College, 1967; M.S., Newark College of Engineering, 1973; Ph.D., physics, New York University, 1983

Professional Experience: physicist, Atomic Energy Commission, 1967–1982; deputy director, Environmental Measurements Laboratory, U.S. Department of Energy, 1982–1987, director, 1987–1991; member, Nuclear Regulatory Commission, 1991–1995; consultant, 1995–

Concurrent Positions: chair, American National Standards Institute, Health Physics Society, 1973–1975, 1980–; co-chair, Committee for International Intercomparison of Environmental Dosimeters, 1974–; U.S. expert delegate, international committee for Development of an International Standard on Thermoluminescence Dosimetry, ca. 1977

Gail De Planque is a renowned expert on radiation, problems of radiation protection, environmental radiation, and nuclear facilities monitoring. After receiving her undergraduate degree in mathematics, de Planque obtained a position as a research physicist with the Radiation Physics Division of what is now the Department of Energy. She was appointed deputy director in 1982 of the Environmental Measurements Laboratory and director in 1987. The Environmental Measurements Laboratory is a direct descendant of the Manhattan Project and is particularly famous for its long-standing global radiation fallout programs as well as research on radiation dosimetry, radon, and radiation problems associated with nuclear facilities and weapons testing. As director, she was responsible for the guidance, direction, and management of the programs, activities, budget, and administrative functions of the laboratory. She currently works as an independent consultant.

In 1997, de Planque was selected to chair the planning committee for a series of conferences to encourage women to become engineers. The project, called Celebration of Women in Engineering, included establishing an educational outreach website called EngineerGirl to encourage engineering as a career choice for young women, and organizing a 1999 conference on the status of women in engineering. According to NAE data, only 9% of engineers are women, even though women receive as many as 20% of undergraduate engineering degrees. Her other professional activities have included extensive participation in standards management and development both nationally and internationally. She is a member of the National Council on Radiation Protection and Measurements and was chair of an International Atomic Energy Agency international advisory committee to study the

radiological situation on the Mururoa and Fangataufa Atolls, the site of French nuclear weapons testing in the South Pacific. She was the U.S. expert delegate to a standards committee to develop an international standard on thermoluminescence dosimetry and a member of the visiting committee for the Department of Advanced Technology of the Brookhaven National Laboratory. She has served on the editorial board of *Radiation Protection Dosimetry* and on the scientific advisory and editorial committees of the series International Conferences on Solid-State Dosimetry.

De Planque was elected a member of the Nuclear Regulatory Commission for the term 1991–1995 and elected to membership in the National Academy of Engineering in 1995. She was elected a fellow of the American Nuclear Society and is a member of the American Physical Society, Association of Women in Science, Health Physics Society, and American Association for the Advancement of Science. In 2003, she received the Henry DeWolf Smyth Statesman Award of the Nuclear Energy Institute, and in 2004, she was inducted into the Women in Technology International (WITI) Hall of Fame.

Further Resources

EngineerGirl. <http://www.engineergirl.org/>.

Women in Technology International Hall of Fame. “Honorable E. Gail de Planque, Ph.D.” <http://www.witi.com/center/witimuseum/halloffame/2004/gdeplanque.php>.

Densen-Gerber, Judianne

1934 2003

Psychiatrist, Physician

Education: B.A., Bryn Mawr College, 1956; L.L.B., Columbia University, 1959, J.D., 1969; M.D., New York University, 1963

Professional Experience: psychiatric resident, Bellevue Hospital, New York City, 1964–1965, Metropolitan Hospital, 1965–1967; staff member, Addiction Services Agency, 1966–1967; founder, Odyssey House, 1966, researcher and clinical director, 1967–1969, executive director, 1967–1983

Judianne Densen-Gerber was a psychiatrist known for her pioneering work in drug rehabilitation. She was also a practicing lawyer and an activist who took up serious social and legal issues, such as child pornography. She received her law degree with the intention of combining it with a medical degree so she could teach medical jurisprudence. However, when her second child died a week after birth, the resulting acute mental stress impelled her to change to psychiatry. She was in

her residency at Metropolitan Hospital in the mid-1960s and pregnant with her third child when she was working in the drug research unit. When some of her patients decided they wanted to quit using an experimental heroin substitute, the hospital administrators feared their research might be jeopardized and removed her from the drug addiction ward. Later, the patients asked her to continue to help them become drug-free, and she founded Odyssey House.

Densen-Gerber theorized that the root cause of drug addiction was psychological, stemming from the individual's sense of hopelessness and lack of self-confidence, and could be addressed in group therapy. Although the communal rehabilitation setting, and preparing the individual to return to normal life, is now standard treatment, it was controversial in the 1960s and subject to a great deal of criticism. When the New York State Department of Social Welfare would not allow Odyssey House to admit anyone under the age of 16, Densen-Gerber pointed out the large number of teenagers who died from heroin overdoses and launched a local and national campaign to obtain funding for a separate juvenile program, which she established in 1971. She continued to receive criticism and harassment from city officials, however, and resigned as head of Odyssey House in 1983. She continued to work as a visiting physician, adjunct professor of law, and consultant.

Densen-Gerber embraced other controversial causes as well. Her work with juvenile addicts drew her attention to the needs of sexually abused children, and she helped write the federal legislation that created the National Center on Child Abuse and Neglect in 1973. She testified on the problem of child pornography before Congress, and also proposed the legalization of marijuana to enable authorities to concentrate on more serious problems, such as heroin addiction. She supported legalization of prostitution for the protection of the women involved. She authored or co-authored several books, including *Drugs, Sex, Parents, and You* (1972), *Child Abuse and Neglect as Related to Parental Drug Abuse and Other Antisocial Behavior* (1978), *Walk in My Shoes: An Odyssey into Womanlife* (1976), and *We Mainline Dreams: The Odyssey House Story* (1973). She was a member of the American Medical Association, Society of Medical Jurisprudence, and American Psychiatric Association.

DeWitt-Morette, Cecile Andrée Paule

b. 1922

Theoretical Physicist

Education: licence és sciences, University of Caen, 1943; diploma, University of Paris, 1944, Ph.D., theoretical physics, 1947

Professional Experience: member, Institute for Advanced Studies, Ireland, 1946–1947; member, University Institute for Theoretical Physics, Copenhagen, 1947–1948; member, Institute for Advanced Study, Princeton University, 1948–1950; teacher and researcher, Institut Henri Poincaré, France, 1950–1951; research associate and lecturer, University of California, Berkeley, 1952–1955; visiting research professor, University of North Carolina, Chapel Hill, 1956–1967, director, Institute of Field Physics, 1958–1966, lecturer, physics, 1967–1971; professor, astronomy, University of Texas, Austin, 1972–1983, professor, physics, 1983–1993, Jane and Roland Blumberg Centennial Professor of Physics, 1993–, professor emerita

Concurrent Positions: visiting professor, Centro de Pesquisa Fisicas, Rio de Janeiro, 1949; director and founder, Summer School of Theoretical Physics, Les Houches, France, 1951–1972; visiting professor: Indian Institute of Science, Bangalore, 1977; Z.I.F. Universität Bielefeld, 1984; Imperial College, London, 1985; University of Warwick, 1985; Universidade da Madeira, 1991

Cecile DeWitt-Morette is an internationally renowned theoretical physicist whose research includes the theory of field elementary particles, mathematical physics, and gravitation. She updated and stabilized physics education in France by founding a summer school of theoretical physics beginning in 1951 with a distinguished and international team of lecturers. L'Ecole de Physique des Houches has been the model for similar programs initiated, with her assistance, in Varenna, Italy, and in the United States as the Battelle Rencontres in Seattle.

She was born in France and was attending college during the World War II German occupation of France. She studied physics, first at the University of Caen and then at the University of Paris, where she worked in a laboratory directed by Nobel Prize recipients Frederic Joliot and Irène Joliot-Curie. With the assistance of the Joliot and the Allied military authorities, she went to study in England in 1946, and then spent a year in Ireland. After receiving her doctorate from the University of Paris, she became a member of the University Institute for Theoretical Physics in Copenhagen for a year, and then was invited to the Institute for Advanced Study at Princeton for two years. In these assignments, she was able to meet and learn from most of the top theoretical physicists in the world at that time, including Richard P. Feynman. Also at Princeton she met her future husband, fellow physicist Bryce S. DeWitt, and they were married in 1951. That same year, she received funding from the French Ministry of Education to start the summer school of theoretical physics in the city of Les Houches, which she directed until 1972.

She and her husband obtained positions at the University of California, Berkeley and then the University of North Carolina, Chapel Hill. Anti-nepotism rules

prevented her from obtaining a tenured position even though she had an international reputation and had been a director of a science institute. In 1972, the couple moved to the University of Texas, Austin, where they both were given tenured positions as full professors. Cecile was initially assigned to the astronomy department owing to fears of nepotism, but the couple continued to collaborate on research and, in 1983, she moved to the physics department.

Dewitt-Morette authored or co-authored several papers and important textbooks on the interplay between physics and mathematics. She received from the French government the Chevalier Ordre National Du Merite (1981) for establishing Les Houches, and she has also received the L'Ordre des Palmes Academiques (1991) and the Prix du Rayonnement Français (1992). She was elected a fellow of the American Physical Society, and she is a member of the European Physical Society.

Diamond, Marian Cleeves

b. 1926

Neuroscientist

Education: B.A., biology, University of California, Berkeley, 1948; Certificate of Courses, University of Oslo, Norway, 1948; M.A., University of California, Berkeley, 1949, Ph.D., anatomy, 1953

Professional Experience: research assistant, Harvard University, 1952–1953; instructor, Cornell University, 1955–1958; lecturer, gross anatomy and neuroanatomy, School of Medicine, University of California, San Francisco, 1958–1960; lecturer, University of California, Berkeley, 1960–1965, assistant professor, anatomy and neuroanatomy, 1965–1974, professor, 1974–

Concurrent Positions: assistant to associate dean, College of Letters and Science, University of California, Berkeley, 1967–1972; director, Lawrence Hall of Science, University of California, Berkeley, 1990–1996; Governor's Board, Rand Graduate School, 1985–1996

Marian Cleeves Diamond is a neuroscientist who studies physical changes in the cerebral cortex area of the brain. She has shown how the cerebral cortex can be changed, positively or negatively, depending on emotions or mental state and on environmental conditions such as diet, exercise, and age. Her research has also shown that, while there are some structural differences between the male and female brains, the individual cortex can be altered and so is not fixed according to sex. Diamond is an affiliated faculty member with both the University of

Berkeley and the University of San Francisco. Her privately funded project, Enrichment in Action, combines her neurological research with a humanitarian educational project at a Cambodian orphanage where she and her colleagues are attempting to improve the children's brain health and future prospects through dietary changes and physical and mental exercise. She has been an invited lecturer at institutions around the world and is the author of over 150 scientific papers and several books, including *Magic Trees of the Mind: How to Nurture Your Child's Intelligence* (1999).

Diamond was born in Glendale, California. Her father was a physician, and she remembers seeing a human brain for the first time in a hospital laboratory when she was still in high school. She attended a local community college, where she first took an anatomy course, before transferring to the University of California, Berkeley, where she completed both her undergraduate and graduate education. She studied neuroanatomy with students enrolled in the medical program and earned a master's degree in anatomy with a study on pain patterns and sensations. In 1953, she was the first woman to receive a Ph.D. in anatomy at Berkeley. Although she spent a few years on the East Coast, at Harvard (where her husband, a nuclear chemist, had an appointment) and as an instructor at Cornell University in New York, she returned to California as a lecturer at the University of California, San Francisco medical school and then returning to Berkeley as a lecturer in 1960. Between 1953 and 1962, she also gave birth to four children, the first of these the same month she received her doctorate. She took a tenure-track position in anatomy and neuroanatomy at Berkeley and advanced to full professor by 1974, where she remains on the faculty of the Department of Integrative Biology. In the 1990s, she spent five years as director of the Lawrence Hall of Science at Berkeley, where she developed exhibits about brains for the public.

Diamond is a fellow of the American Association for the Advancement of Science and the California Academy of Sciences, and was named Alumna of the Year from the California Alumni Association. She has received numerous awards for her teaching, including California Professor of the Year by the Council for Advancement and Support of Education (CASE). She was named a Distinguished Senior Woman Scholar by the American Association of University Women, and has received the California Biomedical Research Association Distinguished Service Award, a University Medal of La Universidad del Zulia, Maracaibo, Venezuela, a Brazilian Gold Medal of Honor, and the Benjamin Ide Wheeler Service Award.

Further Resources

University of California, Berkeley. Faculty website. http://ib.berkeley.edu/research/interests/research_profile.php?person=57.

Squire, Larry R., ed. 2006. *The History of Neuroscience in Autobiography*. Vol. 6. Society for Neuroscience. San Diego, CA: Academic Press (Harcourt).

“Enrichment in Action.” http://www.newhorizons.org/neuro/diamond_cambodia.htm.

Dicciani, Nance Katherine

b. 1947

Chemical Engineer

Education: B.S., Villanova University, 1969; M.S., University of Virginia, 1970; Ph.D., chemical engineering, University of Pennsylvania, 1977, M.B.A., 1986

Professional Experience: superintendent of water treatment, City of Philadelphia, 1972–1974; research engineer, Air Products and Chemicals, Inc., 1977–1978, research manager, 1978–1981, director of research, process systems, 1981–1984, division director of research and development, 1984–1986, division general manager, 1986–1988, director of commercial development, 1988–1991; vice president and business director, Petroleum Chemicals Division, Rohm and Haas Company, 1991–2002; president and CEO, Specialty Materials Division, Honeywell, 2002–

Nance Dicciani has been at the forefront of medical engineering research, making contributions to the application of new technologies in the areas of petrochemicals, energy, chemical processes, wastewater treatment, and catalysis of the production of commercially important petrochemicals. While still in graduate school, she explored new areas of applying chemical engineering to medical imaging; the result was a pioneering effort in developing the ultrasonic scanning devices that now are used routinely to examine women during pregnancy. As early as the fifth grade, she planned a career in the sciences, and she pursued an undergraduate degree in chemical engineering because that allowed her to combine her love for mathematics with a deep interest in the hard sciences, especially physics and chemistry. After receiving her master’s degree in chemical engineering, she worked for the Philadelphia Department of Public Works, serving three years as the city’s superintendent of water treatment. She returned to graduate school at the University of Pennsylvania in the application of chemical engineering to medical imaging as part of a joint research project by the university, the National Science Foundation, and the government of the Soviet Union. She later returned to the University of Pennsylvania to receive an M.B.A. from Wharton Business School. Her dual background in science and business allowed her to rise rapidly through the ranks in corporate industry positions. In 2002, she was named

President and CEO of Specialty Materials at Honeywell, where she oversees production of a variety of consumer and industry chemical products.

Dicciani has also actively supported science education by serving as a member of the chemical engineering advisory boards at both the University of Virginia and the University of Pennsylvania. She is a member of the American Institute of Chemical Engineers and the Society of Women Engineers, and the former vice president of the Society of Chemical Industry. In 2006, she was appointed to the President's Council of Advisors on Science and Technology (PCAST) and in 2007 received the Distinguished Leadership Award from the American Chemistry Council.

Dick, Gladys Rowena Henry

1881–1963

Microbiologist, Physician

Education: B.S., University of Nebraska, 1900; M.D., Johns Hopkins University, 1907; University of Berlin, 1910

Professional Experience: school teacher, 1900–1901; physician, 1907–1909; researcher, University of Chicago, 1911–1953

Gladys Dick and her husband, George Dick, were celebrated for their joint research on the prevention and treatment of scarlet fever. In 1923, they proved that the hemolytic streptococci was the causative agent. They developed the “Dick test,” a skin test to indicate susceptibility to or immunity from scarlet fever. The test involved injection of a solution into the arm; development of a local redness of the skin indicated susceptibility. The test also was applied to pregnant women as an indication of their likelihood of developing puerperal infection. The Dicks were contenders for the Nobel Prize in Physiology or Medicine in 1925, but no prize was awarded that year. At that time, scarlet fever was endemic to North America and Europe; it struck children, causing crippling complications and a mortality rate of up to 25%. The couple took the unprecedented action of patenting their methods of toxin and antitoxin preparation in order to protect the quality of the preparations. In the late 1920s, they won a lengthy lawsuit against one company for patent infringement and improper toxin manufacture. The antibiotics that were developed during World War II superseded the use of their test; however, the significance of their research cannot be overlooked even today. Gladys later conducted research on polio.

After she received her undergraduate degree in 1900, Gladys spent three years persuading her mother to allow her to enroll in medical school. She taught high school biology for one year and enrolled in graduate courses at the University of

Nebraska. During her internship at Johns Hopkins, she was involved in research on experimental cardiac surgery and blood chemistry. She met her future husband and collaborator while working at the University of Chicago. After a short time in private practice as a physician, she joined her husband at the McCormick Memorial Institute for Infectious Diseases. She and her husband received the Cameron Prize of the University of Edinburgh in 1933 and the Mickel Prize from the University of Toronto in 1926. She was co-author of the book *Scarlet Fever* (1938). She received an honorary degree from the University of Nebraska in 1925 and from Northwestern University in 1928.



Microbiologist and physician Gladys Dick. In the 1920s, Dick co-developed a vaccine for scarlet fever with her husband, George F. Dick. (National Library of Medicine)

Donnay, Gabrielle (Hamburger)

1920–1987

Geologist, Mineralogist

Education: B.A., chemistry, University of California, Los Angeles, 1941; Ph.D., crystallography, Massachusetts Institute of Technology, 1949

Professional Experience: laboratory chemist, Massachusetts General Hospital, Boston, 1944–1945; staff member, Division of Industrial Cooperation, Massachusetts Institute of Technology (MIT), 1945–1946; postdoctoral fellow, Johns Hopkins University, 1949–1950; crystallographer, Geophysical Laboratory, Carnegie Institution of Washington, 1950–1969; professor, crystallography, Department of Geological Sciences, McGill University, Canada, 1970–1981

Concurrent Positions: researcher, U.S. Geological Survey, 1952–1955; guest scientist, Johns Hopkins University

Gabrielle “Gai” Donnay was a geologist and mineralogist and the first woman to receive a doctorate specifically in crystallography, earning her degree from MIT in

1949 with a thesis on the structure of tourmaline. That same year she married Jose D. H. Donnay, a professor of crystallography and mineralogy at Johns Hopkins University with whom she collaborated on dozens of projects and scientific papers for nearly four decades. The Donnays were internationally renowned crystallographers and catalogers in the rapidly expanding field of crystallographic research, publishing two editions of *Crystal Data* (1954 and 1963) for use by scientists. In addition to her numerous scientific papers, in 1969 she compiled a history of the first 50 years of the Carnegie Institution program in geology entitled *Crystallography: Fifty Years of X-Ray Crystallography at the Geophysical Laboratory, 1919–1969*. A mineral, Gaidonnayite, is named for her.

Gai Hamburger was born and received her early education in Germany. She passed the examinations to attend the University of Oxford but immigrated to the United States instead, enrolling at the University of California, Los Angeles (UCLA) in 1937. She was already interested in the structure of crystals as an undergraduate and received her bachelor's degree in chemistry with highest honors from UCLA in 1941. She worked briefly as a blood analyst at Massachusetts General Hospital before enrolling in graduate study in crystallography at MIT, using photographic methods to research the structure of minerals and crystal chemistry. Her research career was subsequently divided between U.S. and Canadian institutions. She held a postdoctoral fellowship at Johns Hopkins, and worked for three years with the U.S. Geological Survey (USGS), but otherwise she spent 20 years as a crystallographer in the Geophysical Laboratory at the Carnegie Institution of Washington, D.C. She left Carnegie in 1970, after her husband retired from Johns Hopkins, and spent a decade as a professor of geological sciences at McGill University in Montreal, Canada. She was a member of the National Committees for Crystallography in both countries and was the first woman named to the Johns Hopkins Society of Scholars (1970).

Further Resources

Martin, Robert F. 1989. "Memorial of Gabrielle Donnay: March 21, 1920 April 4, 1987." *American Mineralogist*. 74:491–493. http://74.125.155.132/search?q=cache:VeJYJWWfGLcJ:www.minsocam.org/ammin/AM74/AM74_491.pdf+gabrielle+donnay&cd=1&hl=en&ct=clnk&gl=us.

Downey, June Etta

1875–1932

Psychologist

Education: B.A., University of Wyoming, 1895; M.A., philosophy and psychology, University of Chicago, 1898; Ph.D., psychology, 1907

Professional Experience: instructor, English and philosophy, University of Wyoming, 1898–1905, professor, 1905–1915, professor, philosophy and psychology, 1915–1932

June Downey was the first woman to head a department of psychology in a state university, and she was honored for her development of one of the earliest scientific personality tests to assess character traits separate from the question of intelligence (popularly tested during her time with IQ tests). She was one of the first psychologists to approach the question of personality scientifically and her work earned her international recognition. Among Downey's other interests were creativity, voluntary and involuntary motor controls, color-blindness, imagery, and esthetics. She spent her entire career at the University of Wyoming and contributed to the growth and development of that school and the program in psychology. During her tenure, she was one of the few faculty members in the school who had a doctorate and was actively engaged in research. The university had few graduate students at the time, but she was able to secure the enthusiastic assistance of undergrads in conducting her research.

Downey studied both psychology and philosophy, but became interested in experimental procedures in psychology during a summer session spent at Cornell. She was not associated with a particular school of psychological thought and had a variety of research interests, but was particularly known for her early work on the analysis of personality through handwriting, the subject of her doctoral dissertation. Her research involved analysis of automatic phenomena, muscle reading (or body language), the reading and writing of mirror script, writing under distraction, the retention of writing skill after lapse of practice, handwriting disguise, and pen lapses. These studies resulted in development of the Downey Individual Will-Temperament Test. The test does not result in a total score; the scores are plotted on a graph, resulting in a "will-profile" for each case. Downey determined that there were three main personality types: the "hairtrigger" or spontaneous type, the "willful" or decisive type, and the "accurate" or methodical type. The work was summarized in her books, *Graphology and Psychology of Handwriting* (1919) and *The Will-Temperament and Its Testing* (1924).

Downey was one of the first women elected to the Society of Experimentalists, a select group of 50 eminent psychologists. She served on the Council of the American Psychological Association (1923–1925) and was a fellow of the American Association for the Advancement of Science. In addition to publishing 6 books and nearly 70 scholarly papers, her literary output included numerous short stories, poems, and plays. Downey came from a pioneer Wyoming family. Her father was one of the founders of the University of Wyoming and president of the board of regents. She also wrote the song "Alma Mater" for the university in 1898.

Further Resources

Hogan, John D. and Matthew S. Broudy. 2000. "June Etta Downey." *The Feminist Psychologist*, Newsletter of the Society for the Psychology of Women, Division 35 of the American Psychological Association. 27(2). (Spring 2000). <http://www.psych.yorku.ca/femhop/June%20Etta%20Downey.htm>.

Drake, Elisabeth (Mertz)

b. 1936

Chemical Engineer

Education: B.S., chemical engineering, Massachusetts Institute of Technology, 1958, D.Sc., chemical engineering, 1966

Professional Experience: staff consultant and engineer, cryogenics and chemical engineering, Arthur D. Little, Inc., 1958–1980, vice president of technological risk management, 1980–1982; professor and chair, chemical engineering, Northeastern University, 1982–1986; vice president and leader, safety, health, and environmental practice, Arthur D. Little, Inc., 1986–1988; independent consultant, technological risk management, 1988–1990; associate director of new technologies, Energy Laboratory, Massachusetts Institute of Technology (MIT), 1990–2001 (director, 1994–1995), emeritus staff, Laboratory for Energy and the Environment, MIT, 2001–2007, emeritus staff, Energy Initiative, MIT, 2007–

Concurrent Positions: lecturer, chemical engineering, University of California, Berkeley, 1971; visiting associate professor, chemical engineering, MIT, 1973–1974

Elisabeth Drake is a chemical engineer who is known for her expertise in safety standards and other aspects of environmental safety. Very early in her career, in 1972, she invented a fractionation method and apparatus. Fractionation separates a mixture into ingredients or into portions having different properties, and an apparatus of this type is a valuable contribution to the chemical industry. After receiving her undergraduate degree, she accepted a position at Arthur D. Little, Inc., an international management and technology consulting firm. Her early work was involved in cryogenics, which is the branch of physics that deals with very low temperatures. The term "cryogenics" was coined about 1955 or 1960, which means that she was working on the cutting edge of research and development in this new field.

Drake was promoted to the senior staff after she completed her doctorate. She switched fields to be manager of risk analysis and then vice president of technical risk management. Risk management is the technique of assessing, minimizing,

and preventing accidental loss to a business through the use of safety measures, insurance, and so forth. She accepted a position as chair of the Chemical Engineering Department at Northeastern University in 1982, then returned to work at A. D. Little as vice president of technical risk management. She continued to consult for the company after she left in 1990 to join the Massachusetts Institute of Technology as associate director of new technology in the Energy Laboratory, becoming director between 1994 and 1995.

She has long been active in committees on safety standards. She was a member of the Technical Pipeline Safety Standards Committee of the U.S. Department of Transportation from 1980 to 1985 and a member of the managing board of the Center for Chemical Process Safety from 1988 to 1990. She has been vice chair of the committee that reviews and evaluates the U.S. Army's chemical stockpile disposal program of the National Research Council since 1993.

She was elected to membership in the National Academy of Engineering in 1992. She is a fellow of the American Institute of Chemical Engineers and a member of the American Association for the Advancement of Science and the American Chemical Society. Her research interests include energy technology, risk assessment and control of hazardous material, liquefied natural gas technology and safety, cryogenic engineering, and risk management.

Dreschhoff, Gisela Auguste-Marie

b. 1938

Radiation Physicist, Geophysicist

Education: B.S., Technical University of Braunschweig, 1961, M.S., 1965, Ph.D., physics, 1972

Professional Experience: staff scientist, radiation protection, Physikalisch Technisch Bundesanstalt, Germany, 1965–1967; research associate, nuclear waste disposal, Kansas Geological Survey, 1971–1972; deputy director, Radiation Physics Laboratory, Space Technology Center, University of Kansas, 1972–1984, co-director, 1984–, adjunct associate professor of geology

Concurrent Positions: visiting assistant professor, physics, University of Kansas, 1972–1974, adjunct assistant professor, 1974–; associate professional manager, Division of Polar Programs, National Science Foundation, 1978–

Gisela Dreschhoff is a geophysicist whose areas of research include nuclear waste disposal, reactor radiation protection, and geophysics of the polar regions. She is

renowned for her research in Antarctica to survey for radioactive uranium, thorium, and potassium. Dreschhoff completed the requirements for her doctorate while working as a research associate and then as a visiting assistant professor of physics and astronomy at the University of Kansas. In 1972, she was appointed deputy director of the Radiation Physics Laboratory at Kansas, where she collaborated for many years with her husband, Edward Zeller, also a geophysicist, for whom the Zeller Glacier in Antarctica was named (Zeller died in 1996). In 1978, Dreschhoff was appointed by the National Science Foundation to coordinate and manage the airborne surveys for the entire geophysics program that the foundation sponsored there. The project was the start of a general radiometric survey to determine the distribution of uranium, thorium, and radioactive potassium, if any, and formulate international policy to govern the future use of resources buried under the polar ice. The survey was planned to last at least five years, and the team experimented with a new system that combined airborne surveys with on-the-ground measurements.

After completing her undergraduate training at Braunschweig, Dreschhoff obtained a position as a staff scientist at Physikalisch Technisch Bundesanstalt in Germany, where she was involved in safety procedures to be used around nuclear reactors. In 1965, she was measuring the levels of radioactive fission products in German air, soil, water, and plants. In 1967, when she attended a conference sponsored by the International Atomic Energy Agency, she met an American scientist from the University of Kansas who was working on the effects of radiation on solid bodies in space. He had several contracts from the National Aeronautics and Space Administration (NASA) and the U.S. Air Force and offered her a job. Because she speaks fluent German as well as English and French, she was a valuable participant in international research projects.

Until the late 1960s, American women scientists were not permitted to conduct research in Antarctica, although women from other countries were permitted to do so by their respective governments. The reasoning behind the prohibition was that the only transportation to Antarctica was provided by the U.S. Navy, and that civilian women would not be transported, although there had been a few American women who had financed their own trips. At one point, she was the only woman living at a remote base during the research season with 15 other scientists and an equal number of naval personnel. Dreschhoff is a member of the American Physical Society, American Geophysical Union, American Polar Society, American Association for the Advancement of Science, Explorers' Club, and U.S. Naval Institute.

Further Resources

Land, Barbara. 1981. *The New Explorers: Women in Antarctica*. New York: Dodd, Mead.

Dresselhaus, Mildred (Spiewak)

b. 1930

Solid-State Physicist

Education: B.A., Hunter College, 1951; M.A., Radcliffe College, 1953; Ph.D., physics, University of Chicago, 1958

Professional Experience: Fulbright fellow, Cavendish Laboratory, Cambridge University, 1951–1952; National Science Foundation fellow, Cornell University, 1958–1960; staff member, Lincoln Laboratory, Massachusetts Institute of Technology (MIT), 1960–1967, Abby Rockefeller Mauze Visiting Professor, electrical engineering and computer science, 1967–1968, professor, 1968–1973, associate department head, 1972–1974, Abby Rockefeller Mauze Professor of Electrical Engineering, 1973–1985, director, Center for Materials Science and Engineering, 1977–1983, professor, physics, 1983–1985, Institute Professor, MIT, 1985–

Concurrent Positions: director, Office of Science, U.S. Department of Energy, 2000–2001

Mildred Dresselhaus is a physicist renowned for her research on electronic properties of materials such as semiconductors and semimetals. Solid-state physicists deal with matter in a condensed state, not in gaseous or liquid form, a new area of research when Dresselhaus began her career in the 1950s. The launch of the Russian satellite *Sputnik* in 1957 sparked an interest in the United States in research on new materials, including superconductors, such as lead and tin. Her most important work, starting in the 1980s, was done on analyzing carbon. She and her associates found that carbon contained hollow clusters, each containing 60 atoms. These clusters are called Buckminster Fullerenes (named for the scientist Buckminster Fuller), or Buckeyballs, because of their shape. They are important for their potential use as a delivery system for drugs and as an extremely strong form of wire tubing.

After completing her doctorate at the University of Chicago, she married Gene Dresselhaus, a fellow physics student. He had already accepted a position at Cornell University, and she accepted a National Science Foundation fellowship to work there. After two years, the couple found joint appointments at Massachusetts Institute of Technology, where, in 1977, she was named director of the Center for Materials Science and Engineering. She went on to hold a joint appointment as professor in engineering and physics. At MIT, she has also been committed to encouraging more women to pursue the sciences and engineering.

Dresselhaus has the distinction of having been elected to membership in both the National Academy of Engineering (1974) and the National Academy of

Sciences (1985). She is also a fellow of the American Academy of Arts and Sciences and the American Physical Society (president, 1984), and a member of the Institute of Electrical and Electronics Engineers (IEEE) and the Society of Women Engineers (SWE). She has received numerous honorary doctorates, and her other prestigious awards include the National Medal of Science (1990), the Weizmann Institute Millennial Lifetime Achievement Award (2000), the Nicholson Medal of the American Physical Society (2000), the Karl T. Compton Medal for Leadership in Physics from the American Institute of Physics (2001), the Founders Medal of the IEEE (2004), and the Heinz Award in Technology, the Economy, and Employment (2005). In 2007, she was named the North American Laureate for the L'Oréal-UNESCO Awards for Women, and in 2009, she received the Vannevar Bush Award of the National Science Board for public service as a scientist.

Further Resources

Byers, Nina and Gary A. Williams. 2006. *Out of the Shadows: Contributions of Twentieth-Century Women to Physics*. New York: Cambridge University Press.

Massachusetts Institute of Technology. Faculty website. http://web.mit.edu/physics/people/faculty/dresselhaus_mildred.html.

Dunbar, Bonnie J.

b. 1949

Biomedical Engineer, Ceramics Engineer, Astronaut

Education: B.S., ceramic engineering, University of Washington, 1971, M.S., ceramic engineering, 1975; Ph.D., biomedical engineering, University of Houston, 1983

Professional Experience: staff engineer, Boeing Computer Services, 1971–1973; senior research engineer, Space Division, Rockwell International, 1976–1978; staff engineer, National Aeronautics and Space Administration (NASA), 1978–1980, astronaut, 1981–1998, assistant director, University Research and Affairs, 1998–2003; deputy associate director, Biological Sciences and Applications, 2003–2005; associate director, Technology Integration and Risk Management, 2005; president and CEO, Museum of Flight, 2005–

Concurrent Positions: visiting scientist, Harwell Laboratories, England, 1975; adjunct assistant professor, mechanical engineering, University of Houston

Bonnie J. Dunbar has spent more hours in space than any of the other women astronauts except **Shannon Lucid**. Dunbar joined NASA as a staff engineer in

1978 and performed key guidance and flight control duties for the Skylab reentry mission in 1979. She was accepted for the astronaut training program in 1980, one of the eight original women astronauts. Her first shuttle flight was aboard STS-61-A *Challenger* in October 1985. On STS-32 in 1990, she had the major responsibility for the Remote Manipulator System (RMS) to retrieve a satellite. As payload commander for the 1992 space shuttle *Columbia* flight, she oversaw experiments in materials science, fluid dynamics, combustion science, and biotechnology. She flew a fourth mission on STS-71 in 1995. Her last flight as an astronaut was as a member of the *Endeavour* crew that picked up David Wolf when he completed his *Mir* assignment in 1998. Dunbar retired from NASA in 2005 and became president and CEO of the Museum of Flight in Seattle, Washington, where, in 2008, she held an event called *WomenFly!* to encourage and showcase careers of women in aerospace and aviation. Her husband, Ronald M. Sega, is also an astronaut, engineer, and physicist with NASA.

Dunbar became fascinated with space flight as a child and, encouraged by a teacher, studied all of the math and science courses that were available in high school. At the University of Washington, there were only 6 women in the class of 2,000 engineering students. She originally planned to major in aeronautical engineering, but the head of the Ceramic Engineering Department, who had received a NASA contract to work on thermal insulation systems for the space shuttle, was recruiting students, and she switched to that program. As a graduate student, she had a short appointment as a visiting scientist at Harwell Laboratories in England to do research on turbine blades in aircraft engines, which must withstand extremely high temperatures. She joined the Rockwell International Space Division, the prime contractor for the space shuttle, to help develop equipment and processes for the manufacture of the space shuttle's ceramic-tile heat shield.



Astronaut Bonnie Dunbar prepares for a mission aboard the Space Shuttle *Endeavour*, 1998. (NASA)

After joining the NASA astronaut program, she went on to pursue her Ph.D. in bioengineering, studying the effect of space flight on bone strength and calcium.

Dunbar was elected to the National Academy of Engineers in 2002. Among her numerous awards and honors, she has received the Rockwell International Engineer of the Year (1977), American Ceramic Society (ACS) Greaves-Walker Award (1985), NASA Space Flight Medals (1985, 1990, 1992, 1995, and 1998), NASA Exceptional Service Medal (1988, 1991, and 1996), National Engineering Award of the American Association of Engineering Societies (1992), Museum of Flight Pathfinder Award (1992), *Design News's* Engineering Achievement Award (1993), Institute of Electrical and Electronics Engineers (IEEE) Judith Resnik Award (1993), Society of Women Engineers Resnik Challenger Medal (1993), NASA Outstanding Leadership Award (1993), and James I. Mueller Award of the ACS (2000). She was a member of the National Science Foundation (NSF) Engineering Advisory Board (1993–1999) and has been inducted into the Women in Technology International (WITI) Hall of Fame (2000). She is a member of the American Association for the Advancement of Science, American Ceramic Society, Biomedical Engineering Society, Materials Research Society, National Institute of Ceramic Engineers, Arnold Air Society, and Angel Flight.

Further Resources

Kevles, Bettyann H. 2003. *Almost Heaven: The Story of Women in Space*. New York: Basic Books.

National Aeronautics and Space Administration. “Bonnie J. Dunbar (Ph.D.)” <http://www.jsc.nasa.gov/Bios/htmlbios/dunbar.html>.

E

Earle, Sylvia Alice

b. 1935

Marine Botanist, Oceanographer, Environmentalist

Education: B.S., Florida State University, 1955; M.A., Duke University, 1956, Ph.D., botany, 1966

Professional Experience: research biologist, U.S. Fish and Wildlife Service, 1957; instructor, biology, St. Petersburg Junior College, 1963–1964; research associate, marine biology, Cape Haze Marine Laboratory, 1964–1965, resident director, 1966–1967, senior research associate, 1967–; instructor, Tulane University, 1968; research fellow, Farlow Herbarium, Harvard University, 1967–1975, researcher, 1975–; research scholar, Radcliffe Institute for Independent study, 1967–1969; research associate, botany, Natural History Museum of Los Angeles County, 1970–1975; research biologist and curator, California Academy of Sciences, 1976–; research associate, University of California, Berkeley, 1969–1975; chief scientist, U.S. National Oceanic and Atmospheric Administration (NOAA), 1990–1992, advisor to the administrator, 1992–1993; founder, director, and officer, Deep Ocean Technology, Inc., and Deep Ocean Engineering, Inc., 1981–1990; founder and chair, Deep Ocean Exploration and Research (DOER), 1992–; director, Sustainable Seas Expeditions, National Geographic/NOAA/Goldman Foundation, 1999–2003; program director, Harte Research Institute for the Gulf of Mexico, Texas A&M University, 2000–; executive director, Global Marine Conservation, Conservation International, 2001–

Concurrent Positions: fellow in botany, Natural History Museum, 1989–; director, Kerr-McGee Corporation, 1998–; explorer in residence, National Geographic, 1998–; director, Common Heritage Corporation, 1999–

Sylvia Earle is known internationally as a marine botanist and oceanographer. She was the first female chief scientist of the National Oceanic and Atmospheric Administration (NOAA); during her tenure there, she led investigations into the pollution of the Persian Gulf that resulted from Iraq's burning of the Kuwait oil refineries. She also studied the pollution of Prince William Sound, Alaska, after

the supertanker *Exxon Valdez* ran aground there in 1989. Earle eventually earned the nickname “Her Deepness” for her record-breaking and numerous dives, including a 1979 dive to 1,250 feet in which she spent two and a half hours on the ocean floor.

Earle spent part of her childhood on a farm in New Jersey, where she studied the aquatic life in a pond on the property. Later, when the family moved to Florida, she had the entire Gulf of Mexico as her backyard and learned to scuba dive at a time when very few people dove recreationally and marine biologists were just taking advantage of new diving technologies. Earle graduated from high school at 16 and quickly went on to college and then graduate school at Duke University, where she studied algae. In 1964, she was invited to join an expedition to the Indian Ocean sponsored by the National Science Foundation, and in 1966, the year she received her Ph.D., she became resident director of the Cape Haze Marine Laboratory.

In 1970, Earle was appointed team leader of the group of women oceanographers who lived underwater for two weeks in Tektite II. The purpose was not only to observe the marine environment but also to determine the effects of isolation on aquanauts as a way for NASA to plan for the needs of astronauts on future space flights. The sponsors would not allow male and female scientists to live together and, although there were 16 tests involving all-male teams, the women’s test received the most publicity. As team leader, Earle received invitations to give speeches and publish articles, providing important opportunities to talk about her research on the environment and marine life.

In 1982, she formed a company, Deep Ocean Engineering, with Graham Hawkes, an engineer who had designed a special dive suit worn by Earle. Their company designed and manufactured the Deep Rover, an easily maneuverable, relatively inexpensive, one-person submersible capable of going to an ocean depth of 3,000 feet. Earle was one of the first three individuals to test it and, although she and Hawkes were married but then divorced, she remains involved in the operation of the company. In 1990, she became chief scientist at NOAA, but she left the position to work independently again. In 1999, she returned to a project sponsored by NOAA and National Geographic, a five-year study of the National Marine Sanctuary called the Sustainable Seas Expedition.

In addition to her numerous magazine articles, ocean atlases, and children’s books, Earle’s other books include *Sea Change: A Message of the Oceans* (1996) and *The World Is Blue: How Our Fate and the Ocean’s Are One* (2009). She is a corporate member of the Woods Hole Oceanographic Institution and was the first woman to receive the Lowell Thomas Award of the Explorers’ Club (1980). She is a fellow of the American Association for the Advancement of Science and a member of the International Phycological Society, Phycological Society of

America, American Society of Ichthyologists and Herpetologists, American Institute of Biological Sciences, and Ecological Society of America. She was inducted into the National Women's Hall of Fame in 2000. She is listed as "Sylvia Mead" in some sources.

Further Resources

Harte Research Institute. "Dr. Sylvia Earle." http://www.harteresearchinstitute.org/index.php?option=com_content&view=article&id=98%3Aadr-sylvia-earle-&catid=19%3Aadvisory-board&Itemid=291.

Eastwood, Alice

1859 1953

Botanist

Education: public schools

Professional Experience: high school teacher, Denver, 1879–1890; curator of botany, California Academy of Sciences, 1892–1950

Alice Eastwood was one of the most knowledgeable systematic botanists of her time. She was curator of botany at the California Academy of Sciences for more than 50 years and was a specialist on the flowering plants of the Rocky Mountains and the California coast. In a study of 100 prominent American botanists in 1903, she was one of only two women named. While teaching high school in Denver, she acquired an extensive knowledge of botany by exploring various areas of Colorado. She was invited in 1892 to join Kate Brandegee, curator of botany at the California Academy of Sciences, and later succeeded her as curator. Both were members of a group of prominent botanists who were working in California at the turn of the century. In 1893, Eastwood published, at her own expense, *Popular Flora of Denver, Colorado*. In 1905, she wrote *A Handbook of the Trees of California*. In 1932, she and J. T. Howell founded and edited the journal *Leaflets of Western Botany*. This was an important outlet for the active research that was being conducted in the western United States. She founded the California Botanical Club and directed its activities thereafter. In addition to her work at the Academy, she was able to perform extensive fieldwork in California and added hundreds of specimens to the collection.

After the San Francisco earthquake and fire of 1906, Eastwood spent several years rebuilding the botanical collections at the California Academy of Sciences. She verified the descriptions of specimens by visits to the British Museum, the

Kate Brandegee

Mary Katharine Layne Curran Brandegee (1844–1920) was one of the outstanding women botanists in the United States in the nineteenth century and was a leading authority on California plants. After her first husband died in 1874, she obtained an M.D. from the University of California at San Francisco. The curriculum included training in the medicinal uses of plants and, after practicing medicine for a few years, she joined the California Academy of Sciences. She began actively collecting specimens and in 1883 became curator of the herbarium, a position she held for 10 years, and one of the highest-level botany positions for a woman at that time. In this post, she edited and published a series of botanical *Bulletins*. Later, with her husband Townshend Brandegee, a civil engineer and plant collector, she co-founded *Zoe*, a journal of the natural history of the west coast. In 1898, the Brandegees moved to San Diego, where they built their own botanical library and herbarium. They returned to San Francisco in 1906 when Townshend Brandegee accepted a position as honorary curator at the University of California. They spent the rest of their lives at the herbarium, without salary, donating their library and collection of over 75,000 specimens to the university.

Royal Botanic Gardens, the Natural History Museum at Paris, Harvard University, the New York Botanical Garden, and the National Herbarium. Between 1912 and her retirement in 1950, over 340,000 specimens were added to the herbarium. One of her goals was to verify the classification of tropical and subtropical exotics grown in California. She also was responsible for developing the Academy's vast botanical library, which included many volumes she contributed from her personal collection.

Eastwood published about 300 scientific papers. Among the honors she received was being elected honorary president of the Seventh International Botanical Congress in Stockholm in 1950. She was a member of the American Association for the Advancement of Science, the Botanical Society of America, and the Ecological Society of America. Carol G. Wilson wrote a biography, *Alice Eastwood's Wonderland: The Adventures of a Botanist* (1955).

Further Resources

- Bonta, Marcia M. 1995. *American Women Afield: Writings by Pioneering Women Naturalists*. College Station: Texas A&M University Press.
- Rudolph, Emanuel D. 1982. "Women in Nineteenth Century American Botany: A Generally Unrecognized Constituency." *American Journal of Botany*. 69(8): 1346–1355.

Edinger, Tilly

1897 1967

Paleontologist

Education: University of Heidelberg and University of Munich, 1916–1918; Ph.D., natural philosophy, University of Frankfurt, 1921

Professional Experience: research assistant, paleontology, University of Frankfurt, 1921–1927; curator, vertebrate collection, Senckenberg Museum of Frankfurt, 1927–1938; translator, 1939; research associate, Museum of Comparative Zoology, Harvard University, 1940–1967

Tilly Edinger was the first person to perform systematic work on the study of fossil brains. She proved that the brain's evolution could be studied directly from fossils. She recognized that the evolution of the brain must be studied directly from the fossils and that mammals' brains are uniquely suited to such study. She theorized that the evolution of the brain was more complex than other paleontologists had stated. She worked for a number of years as curator of the vertebrate collection, without pay, in the museum in Frankfurt, Germany. Five years after the Nazis came to power, she was forced to flee the country due to her Jewish heritage. She came to Harvard because the school had designated funds for the temporary employment of displaced European scholars. She spent the rest of her life at Harvard's Museum of Comparative Zoology. She published the first of her major works while still in Germany: *Die Fossilen Gehirne* (1929). Her second book, *The Evolution of the Horse Brain* (1948), was published while she was at Harvard.

Edinger virtually established the field of paleoneurology, the study of fossil brains. Her father was a famous medical researcher who helped found the science of comparative neurology. She did not originally intend to follow in his footsteps. She planned to study geology but, fearing there were few employment opportunities in that field for women, she switched to vertebrate paleontology and ultimately ranked among the major figures in her field. She was elected president of the Society of Vertebrate Paleontology (1963–1964) and received honorary degrees from Wellesley College (1950), the University of Giessen (1957), and the University of Frankfurt (1964).

Edwards, Cecile Hoover

1926 2005

Nutritionist, Biochemist

Education: B.S., Tuskegee Institute, 1946, M.S., 1947; Ph.D., nutrition, Iowa State University, 1950; diplomate, human nutrition, American Board of Nutrition, 1963

Professional Experience: research associate, nutrition, Iowa State University, 1949–1950; assistant professor and research associate, foods and nutrition, Tuskegee Institute, 1950–1956, department head, 1952–1956; professor, nutrition, North Carolina A&T State University, 1956–1971, department chair, home economics, 1968–1971; department chair, home economics, Howard University, 1971–1974, dean, School of Human Ecology, 1974–1986, professor, nutrition, 1971–2000

Concurrent Positions: dean, School of Continuing Education, Howard University, 1986–1987; collaborator, Bureau of Human Nutrition and Home Economics, Agricultural Research Service, U.S. Department of Agriculture, 1952–1955; adjunct professor, University of North Carolina, Chapel Hill, 1971; project director, National Institute of Child Health and Human Development, 1985–1989

Cecile Edwards was a researcher and educator who devoted her career to improving the nutrition and well-being of disadvantaged people. She accepted a position at Howard University in 1971 as chair of the Department of Home Economics, but was assigned the task of designing a new curriculum for the School of Human Ecology. In 1969, Arthur Jensen had advanced the theory in a scientific paper that blacks were genetically inferior and that providing education, nutrition, and other resources could not bring them into equality. Edwards's major goal was to disprove the Jensen hypothesis. Her school evaluated programs that provided resources for low-income people and taught parenting, childcare, nutrition, budgeting, and job skills as part of a comprehensive approach. She was ultimately responsible for helping to establish the Ph.D. program in nutrition at Howard University.

Edwards enrolled in the Tuskegee Institute at the age of 15 with a major in home economics and went on to earn graduate degrees in nutrition and chemistry, in particular studying methionine, an essential amino acid. She returned to Tuskegee as a faculty member and research associate and was appointed head of the Department of Foods and Nutrition in 1952. She later expanded her research to the amino acid composition of food, the utilization of protein from vegetarian diets, and the planning of well-balanced and nutritious diets, especially for low-income and disadvantaged people both in the United States and abroad.

Starting in 1985, Edwards directed a five-year project sponsored by the National Institute of Child Health and Human Development to study the nutritional, medical, psychological, socioeconomic, and lifestyle factors that influence pregnancy outcomes for low-income and minority women. She served on numerous commissions and committees involving human health and nutrition and was a member of the American Institute of Nutrition, American Home Economics Association, Society for Nutrition Education, and American Dietetic Association. In 1984, her home state of Illinois declared April 5 as “Dr. Cecile Hoover Edwards

Day,” and in 2000, the Illinois legislature passed a resolution honoring Edwards upon her retirement from Howard University.

Edwards, Helen Thom

b. 1936

Accelerator Physicist

Education: B.A., Cornell University, 1957, M.A., 1963, Ph.D., physics, 1966

Professional Experience: research associate, Laboratory for Nuclear Studies, Cornell University, 1958–1970; research, Fermi National Accelerator Laboratory, 1970–1987, head, Accelerator Division, 1987–1989; head and associate director, Superconducting Division, Superconducting Supercollider Laboratory, 1989–1992; guest scientist, Fermi National Accelerator Laboratory, Office of Science, Department of Energy, 1992–

Helen Edwards is an internationally renowned physicist who supervises the design and building of accelerators. She has been responsible for two of the largest in the United States: the Tevatron at Fermi Laboratory (Fermilab) in Illinois and the Superconducting Supercollider in Texas. Unfortunately, the latter project has never been completed due to lack of Congressional funding, but she divides her time between Fermilab (where her husband, Don Edwards, is also a physicist) and the Deutsches Elektronen Synchrotron (DESY) in Hamburg, Germany. Her goal is to develop an international superconducting linear collider to enable scientists to gather data on the nature of subatomic particles. The construction of a particle accelerator is a complicated operation requiring the effort of hundreds of people. Edwards has served as a chief designer, group leader, and project coordinator at these laboratories.

Edwards pursued her graduate studies at Cornell due to the school's international reputation for pioneering work in the construction of particle accelerators. She was appointed a research associate in the Laboratory for Nuclear Studies, where she was primarily responsible for commissioning (or ensuring that it was in operating order) the 12-GeV electron synchrotron. A synchrotron, which also is called an *atom smasher* or *particle accelerator*, is an electrostatic or electromagnetic device that produces high-energy particles and focuses them on a target. The GeV is a unit of measurement for the energy level of accelerated particles equivalent to a billion electron volts. In 1970, Edwards was invited to join the research team at the Fermi Laboratory, where she was instrumental in commissioning the 400-GeV main accelerator and commissioning auxiliary equipment.

In 1987, she was one of the supervisors assigned to oversee the completion of the world's highest-energy superconducting particle accelerator, called the Tevatron. This accelerator can produce an energy level of 1 TeV, the equivalent of 1,000 GeV, as it collides protons and antiprotons moving in opposite directions.

Edwards was elected to the National Academy of Engineering in 1988. She has received the U.S. Department of Energy's Ernest O. Lawrence Award (1986) and a prestigious MacArthur Fellowship (1988). She was a co-recipient of the President's National Medal of Technology (1989) and in 2003 received the Robert R. Wilson Prize of the American Physical Society "for her pivotal achievement and critical contribution as the leader in the design, construction, commissioning and operation of the Tevatron, and for her continued contributions to the development of high-gradient superconducting linear accelerators as well as bright and intense electron sources."

Further Resources

Byers, Nina and Gary A. Williams. 2006. *Out of the Shadows: Contributions of Twentieth-Century Women to Physics*. New York: Cambridge University Press.

Ehrlich, Anne (Fitzhugh) Howland

b. 1933

Environmental Scientist, Author

Education: student, University of Kansas, 1952–1955

Professional Experience: technician, entomology, University of Kansas, 1955; research assistant and biological illustrator, biological sciences, Stanford University, 1959–1972, research associate, 1972–1975, senior research associate, 1975–; associate director/policy coordinator, Center for Conservation Biology, Stanford University, 1987–

Concurrent Positions: consultant, Council on Environmental Quality, 1977–1980; instructor, biology and environmental policy, Stanford University, 1981–

Anne Ehrlich has had a great impact on the debates about population growth, food resources, extinction of species, and human ecology. In 1984, her husband, Paul R. Ehrlich, a professor of biological sciences and population studies, founded the Center for Conservation Biology at Stanford University, and in 1987, Anne was appointed Policy Director. Anne Ehrlich has authored or co-authored more than 10 books on controversial topics. In one of the couple's most recent books,

Betrayal of Science & Reason: How Anti-Environmental Rhetoric Threatens Our Future (1996), they argue that overpopulation, global warming, and natural resource limits continue to threaten human life and the planet.

The Ehrlichs have been especially criticized for their population forecasts and ominous warnings. In 1968, when they published *The Population Bomb*, there were 3.5 billion human beings. The Ehrlichs warned that the planet could not support that number of people and predicted that in the 1970s, famines would result in millions of human deaths. In fact, their critics pointed out, the decade saw food production soar worldwide, prices dropped, and growers experienced a surplus. But the Ehrlichs issued a sequel, *The Population Explosion*, in 1990; by that time, world population

was at 5.3 billion, and they stated that the excess numbers of people had overloaded both the environment and human communities, and the result will be global warming, acid rain, a larger hole in the ozone layer, crime, viral epidemics, and homelessness. While it is difficult to find consensus on the extent or urgency of such problems as related to population increases, many of the environmental problems the Ehrlichs warned about have become prominent concerns and political issues of the twenty-first century.

Anne Ehrlich has served as a consultant for or member of numerous government and academic committees and organizations, including the White House Council on Environmental Quality's Global 2000 Report (1980), Conferences on the Fate of the Earth (1981–1984), the Center for Innovative Diplomacy (1981–1992), the President's Commission on Sustainable Development (1994–1995), the Rocky Mountain Biological Laboratory (1989–1999), the Ploughshares Fund (1990–2003), and the Sierra Club (1996–2002). She has also served on numerous advisory panels and was on the editorial board of *Pacific Discovery*, the journal of the California Academy of Sciences (1998–1994).

The Ehrlichs have received numerous honors and awards together, including the American Humanist Association Distinguished Service Award (1985), the United



Anne Ehrlich is a biologist specializing in population issues. She is policy coordinator of the Center for Conservation Biology at Stanford University. (Stanford University)

Nations Environment Programme Prize (1994), the Heinz Award for Environmental Achievement (1995), and the Distinguished Peace Leader Award of the Nuclear Age Peace Foundation (1996). When the couple won the Tyler Prize for Environmental Achievement (1998), they used a portion of their prize money to buy and restore a piece of eroded land in Costa Rica. Anne Ehrlich has also received several awards for her separate work, including being named to the Global 500 Roll of Honour for Environmental Achievement of the United Nations (1989). She is an honorary fellow of the California Academy of Science, an honorary lifetime member of the American Humanist Association, and a fellow of the American Academy of Arts and Sciences. She has received honorary doctorates from Bethany College (1990) and Oregon State University (1999).

Further Resources

Center for Conservation Biology, Stanford University. Staff website. <http://www.stanford.edu/group/CCB/Staff/anne.htm>.

Elders, (Minnie) Joycelyn (Jones)

b. 1933

Endocrinologist, Pediatrician

Education: B.A., Philander Smith College, 1952; certified physical therapist, Brooks Army Medical School, 1954; M.D., University of Arkansas, 1960; diplomate, American Board of Pediatrics, 1964; M.S., biochemistry, University of Arkansas Medical School, 1967

Professional Experience: intern, pediatrics, University of Minnesota Hospital, 1960–1961; resident, Medical Center, University of Arkansas, 1961–1964, instructor, 1964–1967, assistant professor, 1967–1971, associate professor, 1971–1974, professor of pediatrics, 1976–1987; Chief Public Health Director, Arkansas Department of Health, 1987–1993; Surgeon General, U.S. Department of Health and Human Services, 1993–1994; professor of pediatrics, College of Medicine, University of Arkansas for Medical Sciences, 1994–2002, emerita, 2002–

Concurrent Positions: research fellow, National Institute of Child Health and Human Development, 1964–1967

Joycelyn Elders was the second woman and the first African American to be appointed to the post of Surgeon General of the United States, succeeding the first woman to hold the post, **Antonia Novello**. Her medical specialty is endocrinology,



Endocrinologist and pediatrician Joycelyn Elders was the second woman and the first African American to be appointed Surgeon General of the United States, 1994. (AP/Wide World Photos)

which is the branch of biology dealing with the endocrine glands and their secretions; this includes the thyroid, the adrenal, and the pituitary. Elders was a sharecropper's daughter in rural Arkansas who worked as a maid to pay her way through undergraduate school. After completing her residency, she joined the pediatrics faculty of the University of Arkansas Medical Center. In 1987, then-governor Bill Clinton appointed her director of the Arkansas Department of Health. In this position, she established school-based health clinics to combat the state's teen pregnancy rate, which was the second-highest in the nation.

President Clinton appointed her Surgeon General in 1993. Her responsibilities were primarily to disseminate information about widespread health problems such as smoking-related illnesses and sexually transmitted diseases. She also managed the commissioned corps, a uniformed service whose members are assigned to medical trouble spots as needed. She was also responsible for the Public Health Service's offices of population affairs, minority health, and women's health, and the President's Council on Physical Fitness and Sports. Her time as surgeon general was plagued by controversy due to her support for controversial measures such as widespread condom distribution, sex education, abortion rights,

imposing higher excise taxes on alcohol as well as on tobacco, and the medical use of marijuana. In 1994, she was forced to resign after just 15 months in office under pressure from conservatives amid controversy over public comments in which she said that masturbation “is a part of human sexuality.” She returned to the University of Arkansas Medical Center as a professor of pediatrics, retiring in 2002.

Elders is a member of the Society for Pediatric Research, Endocrinology Society, and American Federation for Clinical Research. Her autobiography is *Joycelyn Elders, M.D.: From Sharecropper’s Daughter to Surgeon General of the United States of America* (1996).

Further Resources

“Dr. M. Joycelyn Elders.” Changing the Face of Medicine: Celebrating America’s Women Physicians. National Library of Medicine. National Institutes of Health. http://www.nlm.nih.gov/changingthefaceofmedicine/physicians/biography_98.html.

Elion, Gertrude Belle

1918–1999

Biochemist

Education: A.B., Hunter College, 1937; M.S., New York University, 1941

Professional Experience: lab assistant, Biochemistry, School of Nursing, New York Hospital, 1937; assistant organic chemist, Denver Chemical Company, 1938–1939; teacher, chemistry and physics, 1941–1942; analyst, food chemistry, Quaker Maid Company, 1942–1943; research chemist, Johnson & Johnson, 1943–1944; senior research biochemist, Burroughs Wellcome Research Laboratories, 1944–1967, assistant to director, Chemotherapy Division, 1963–1967; head, Experimental Therapy, Burroughs Wellcome Company, 1967–1983, emerita scientist and consultant, 1983–1999

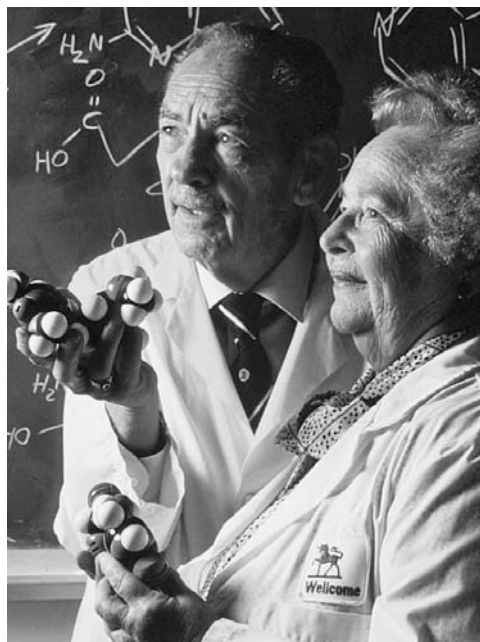
Concurrent Positions: consultant, chemotherapy study section, U.S. Public Health Service, 1960–1964; adjunct professor, pharmacology and experimental medicine, Duke University, 1971–1983, research professor, 1983–1999

Gertrude Elion was an organic chemist, pharmacologist, and leader in the field of purine antimetabolites for the treatment of cancer. Her research earned her the Nobel Prize in Physiology or Medicine in 1988. She and her collaborators developed drugs to interrupt the life cycle of abnormal cells while leaving

healthy cells unharmed, changing the course of pharmaceutical research. In her chemotherapy research, she synthesized and studied drugs used to treat leukemia and to ensure successful organ transplants. Her research was the basis for the development of AZT, the first drug approved by the Food and Drug Administration for AIDS patients, and she contributed to the development of drugs for the treatment of malaria, gout, and viral and bacterial infections. She began working for Burroughs Wellcome (now GlaxoSmithKline) in 1944. Unlike many pharmaceutical companies, Burroughs Wellcome encouraged its scientists to publish their findings once patents had been registered, and she ultimately published more than 225 papers in her own name.

Elion was one of the few scientists in the cancer research field, and one of the few Nobel Prize winners in science, who did not have a doctorate. She graduated from Hunter College *summa cum laude*, but 15 schools rejected her applications for a graduate assistantship because she was a woman. She held marginal jobs for several years until her great potential was recognized at Burroughs Wellcome. By that time, she had completed her master's degree and enrolled in classes toward her doctorate at Brooklyn Polytechnic Institute, which she attended for two years. The college expected her to enroll full-time, but she was unwilling to quit her job. She was awarded an honorary doctorate from the Polytechnic Institute of New York University in 1989, one of numerous honorary degrees she received in her lifetime.

Elion was awarded the highest and most prestigious honors bestowed upon scientists. She was awarded the Garvan Medal in 1968, the Nobel Prize in 1988 (awarded jointly with her colleague and mentor George Hitchings), and the Lemelson-MIT Lifetime Achievement Award in 1997. Elion was elected to the National Academy of Sciences in 1990, and she was awarded the National Medal of Science in 1991. Also in 1991, she was the first woman inducted into the National Inventor's Hall of Fame. She was elected a fellow of the American



George Hitchings, left, and Gertrude Elion, right, won the 1988 Nobel Prize in Physiology or Medicine for their work developing drugs to fight cancer, AIDS, and other diseases. (AP/Wide World Photos)

Academy of Pharmaceutical Scientists. She was a member of the American Chemical Society, the New York Academy of Sciences, and the American Society of Biological Chemists.

Further Resources

McGrayne, Sharon Bertsch. 1998. *Nobel Prize Women in Science: Their Lives, Struggles, and Momentous Discoveries*. Secaucus, NJ: Birch Lane Press.

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

Ellis, Florence May Hawley

1906–1991

Anthropologist

Education: A.B., University of Arizona, 1927; M.A., 1928; Ph.D., anthropology, University of Chicago, 1934

Professional Experience: research associate, Arizona State Museum, 1928–1929; instructor, anthropology, University of Arizona, 1929–1933; assistant to associate professor, anthropology, University of New Mexico, 1934–1953, professor, 1954–1971

Concurrent Positions: adjunct associate professor, University of Chicago, 1937 and 1938–1940; adjunct professor, Eckerd College, 1973

Florence Ellis was known for her pioneer work on the dating of ceramics of the Southwest. She published her first papers in the 1920s, becoming one of the first women to establish herself in the study of early American culture. She originally enrolled as a history major at the University of Arizona, but feeling there were too many dates to remember, she switched to anthropology. Her master's thesis featured ceramics from three closely successive stages found in excavated sites near her hometown of Miami, Arizona. She was able not only to separate the sequential stages but also to suggest the possible Mexican relationship. After receiving her master's degree, she taught at Arizona in the anthropology department and continued her research. In addition to her skill at dating ceramics, she developed expertise in tree-ring dating (dendrochronology). Due to her special skills, she was on loan half-time to the University of Chicago to teach dendrochronology between 1937 and 1940. After receiving her doctorate, she accepted a position at the University of New Mexico, where she remained until her retirement.

Fortunately for Ellis, very little work had been reported on the history and pre-history of the Native Americans of New Mexico. In the 1960s and 1970s, she assisted in the definition of ancient tribal areas for most of the New Mexico and Arizona Pueblo tribes and for the Navajos. She had a major role in the Wetherill Mesa project to establish relationships between prehistoric culture and living peoples. She did extensive work in ethnography and ethnology, particularly in Pueblo and Navajo ethnography. She had close relationships with many Native Americans, who often permitted her to investigate areas that were closed to other ethnologists due to religious principles.

In addition to scientific papers, Ellis published four books: *The Significance of the Dated Prehistory of Chetro Ketl, Chaco Canyon, N. M.* (1934), *Field Manual of Prehistoric Southwestern Pottery Types* (1936), *Tree Ring Analysis and Dating in the Mississippi Drainage* (1941), and *A Reconstruction of the Basic Jemez Pattern of Social Organization* (1964). She was a member of the Society for American Archaeology, American Society for Ethnohistory (president, 1969), Tree-Ring Society, New Mexico Archaeological Society, and Northern Arizona Society for Science and Art. She was active in museum work in New Mexico as a member of the Museum of New Mexico Foundation Board, and a teacher and consultant at the Ghost Ranch Museum, which now houses her personal library and archaeological finds at the Florence Hawley Ellis Museum of Anthropology. She published as both Florence M. Hawley and Florence Hawley Ellis.

Further Resources

Florence Hawley Ellis Museum of Anthropology. <http://www.ghost ranch.org/museums--activities/florence-hawley-ellis-museum-of-anthropology.html>.

Elmegreen, Debra Meloy

b. 1952

Astronomer

Education: B.A., astrophysics, Princeton University, 1975; M.A., astronomy, Harvard University, 1977, Ph.D., astronomy, 1979

Professional Experience: research assistant, Thermophysics Division, Goddard Space Flight Center, 1969, Laboratory of Cosmic Ray Physics, Naval Research Laboratory, 1971–1972, Spectros Division, National Bureau of Standards, 1973, Kitt Peak National Observatory, 1974, Arecibo Observatory, 1975; teaching

fellow, Harvard University, 1977; Carnegie postdoctoral fellow, Mt. Wilson and Las Campanas Observatory, 1979–1981; visiting astronomer, Royal Greenwich Observatory and Institute of Astronomy, Cambridge University, 1981; visiting scientist, T. J. Watson Research Center, IBM Corporation, 1982–1988; assistant professor to professor, astronomy, Vassar College, 1985–

Concurrent Positions: chair, Committee on Status of Women in Astronomy, American Astronomical Society; director, New York State Science Talent Search

Debra Elmegreen is an astronomer whose research on spiral galaxies has resulted in a new method for classifying these galaxies. The primary feature of spiral galaxies is the waves that shape the spiral, waves that arise from the gravitational pulls within the galaxy. The Earth is part of a spiral galaxy, and researchers estimate that spiral galaxies represent about one-third of the estimated 100 billion galaxies in the observable universe. The Earth's galaxy, typical of large spirals, contains about 200 billion stars spread mostly through its disk, which is 100,000 light-years across and about 3,000 light-years thick. A gas, usually hydrogen gas, floats among the stars in the disk. Some of the gas forms clouds, with the largest clouds being concentrated in or near the spiral arms. In conjunction with her husband, astronomer Bruce Elmegreen, Debra Elmegreen has proposed a classification scheme based on the size of the spiral arms, since all spirals have the same components. Because most galaxies seem to be tilted to our line of sight, the researchers use computer imaging to make the arms seem round and to enhance the contrast against the disk.

After receiving her doctorate from Harvard University, she had a series of short appointments at several observatories and was a visiting scientist at IBM. Such a record of research often is just a reflection of the competition for employment in the field of astronomy, as astronomy and related fields receive small amounts of funding compared to the number of qualified people who are searching for positions. She received an appointment as assistant professor of astronomy at Vassar College in 1985, and is now the Maria Mitchell Professor of Astronomy, named after the first American woman astronomer, Maria Mitchell, who served as the first director when the college's observatory was built in the 1860s.

Elmegreen is a member of the American Astronomical Society, Royal Astronomical Society, and International Astronomical Union. Her textbook for undergraduate astronomy courses, *Galaxies and Galactic Structure*, was published in 1998. Some of the images from her Hubble Telescope and National Aeronautics and Space Administration (NASA) Spitzer Space Telescope observations of spiral galaxies were selected as the Space Telescope Science Institute Heritage Image of the Month (November 1999) and the Astronomy Picture of the Day (1999 and 2004).

Further Resources

Vassar College. Faculty website. <http://faculty.vassar.edu/elmegree/>.

Clavin, Whitney. 2006. "Galaxies Don Mask of Stars in New Spitzer Image." Press release. <http://www.spitzer.caltech.edu/Media/releases/ssc2006-11/release.shtml>.

Emerson, Gladys Anderson

1903 1984

Nutritionist, Biochemist

Education: B.S., physics and chemistry, A.B., history and English, Oklahoma College for Women, 1925; M.A., history, Stanford University, 1926; Ph.D., nutrition and biochemistry, University of California, Berkeley, 1932

Professional Experience: assistant, Stanford University, 1925–1926; teacher, social sciences, 1926–1929; assistant, Iowa State College, 1930–1931; research associate, Institute for Experimental Biology, University of California, Berkeley,



Gladys Emerson in the labs at the UCLA School of Public Health. (National Library of Medicine)

1933–1942; department head, nutrition, Merck Institute of Therapeutic Research, 1942–1957; professor and chair, home economics, University of California, Los Angeles, 1957–1961, professor, nutrition and head of division, School of Public Health, UCLA, 1962–1970

Concurrent Positions: advisory board member, Quartermaster Food & Container Institute, 1948–1949; research associate, Sloan-Kettering Institute of Cancer Research, 1950–1953; board member, food and nutrition, National Research Council, 1959–1964

Gladys Emerson was a nutritionist and biochemist who researched amino acids and vitamins and was recognized as the co-isolator of vitamin E while at the University of California, Berkeley in the late 1930s. As an undergraduate, she received a joint degree in both science and history. After receiving a master's degree in history, she taught school for several years. Changing directions in her career, she obtained a fellowship at the University of California, Berkeley, where she received a doctorate in nutrition and biochemistry in 1932. She received an appointment as a research associate at the Institute for Experimental Biology at Berkeley, where she started the research that resulted in isolating vitamin E from wheat germ oil. In 1942, she joined the Merck Institute of Therapeutic Research as head of the department of nutrition. At the University of California, Los Angeles, she became professor and head of the department of home economics and then professor of nutrition and head of the division of the School of Public Health at Los Angeles. She held concurrent positions as a member of the advisory board for the Quartermaster Food & Container Institute (1948–1949), research associate at Sloan-Kettering Institute of Cancer Research (1950–1953), and member of the food and nutrition board of the National Research Council (1959–1964).

Emerson was also associate editor of the *Journal of Nutrition* from 1952 to 1956. She received the prestigious Garvan Medal of the American Chemical Society in 1952. She was a fellow of the American Association for the Advancement of Science, the American Institute of Nutrition, and the New York Academy of Sciences.

Esau, Katherine

1898–1997

Botanist

Education: Golitsin Women's Agricultural College, Moscow, 1916–1917; Agricultural College of Berlin, 1919–1922; Ph.D., botany, University of California, Davis, 1931

Professional Experience: staff, Sloan Seed Company, Oxnard, California, 1923–1924; plant breeder, Spreckels Sugar Company, 1924–1927; assistant, botany, University of California, Davis, 1928–1931, instructor, 1931–1937, assistant professor to professor, botany, 1937–1963; professor, botany, University of California, Santa Barbara, 1963–1965

Concurrent Positions: junior botanist to botanist, agricultural experiment station, University of California, Davis, 1931–1968; Guggenheim fellow, Harvard University, 1940; lecturer, Botanical and Plant Research Institute, University of Texas, 1956; Prather Lecturer, Harvard University, 1960; lecturer, Walker Conference on Plant Pathology, University of Wisconsin, Madison, 1968; Powell Lecturer, American Academy of Art and Science, 1973

Katherine Esau was recognized for her work on the effects of viruses on the structure and development of plant tissues, and was an authority on the food-conducting tissue of plants and plant–host virus relationships. Born in Russia, Esau received college degrees from agricultural schools in Moscow and in Berlin before her family immigrated to the United States in 1922. The family wanted to settle in California to be near a Mennonite community that shared their religious beliefs. California’s agricultural economy was the ideal place for Katherine to find work, and she spent a year on a seed-production ranch in southern California before being hired as a plant breeder by the Spreckels Sugar Company near Salinas. Her primary research task was to develop a hybrid sugar beet that was resistant to a viral disease spread by insects, which caused the plant leaves to curl and wilt. When the head of the botany department at the University of California, Davis visited the Spreckels project, he offered Esau an assistantship at the university to continue her research on sugar beets. She worked with an entomologist at Berkeley to infect her beet plants with the virus-spreading insects and soon moved from a focus on creating a virus-resistant strain of beets to studying the effect of the virus on the plant, or plant pathology. The school determined her previous education in Russia and Germany to be the equivalent of a master’s degree, and she went on to receive her doctorate through a joint program with Davis and Berkeley in 1931. After that, she held a joint position as faculty member and botanist with the agricultural experiment station.

In 1963, Esau moved to the Santa Barbara campus of the University of California to continue collaborative research on plant development and anatomy, especially of crop or food plants. She authored several books, including two of the most widely used and influential botany textbooks, *Plant Anatomy* (1953) and *Anatomy of Seed Plants* (1960), which went through multiple editions through the 1970s. She also authored *Plants, Viruses, and Insects* (1961), *Vascular Differentiation in Plants* (1965), and *Viruses in Plant Hosts* (1968). Although she officially retired in

1965, Esau continued her research for another 30 years. She died in 1997 at the age of 99.

Esau was elected to membership in the National Academy of Sciences in 1957. She was also an elected member of Phi Beta Kappa and of the Swedish Royal Academy of Sciences. She was president of the Botanical Society of America in 1951, was awarded a Certificate of Merit from the Botanical Society of America in 1956, and in 1989, she received the National Medal of Science from President George H. W. Bush “[i]n recognition of her pioneering research, both basic and applied, on plant structure and development, which has spanned more than six decades . . . and for providing a special role for women in science.” She was a member of the American Philosophical Society, the American Academy of Art and Science, the International Society of Plant Morphologists, and the Botanical Society of America, which has established a Katherine Esau Award for graduate students in her name.

Further Resources

Evert, Ray F. 1985. “Katherine Esau.” *Plant Science Bulletin*. 31(5). (October 1985). <http://www.botany.org/bsa/misc/esau.html>.

University of California. “Katherine Esau, Biological Sciences: Santa Barbara.” <http://content.cdlib.org/xtf/view?docId=hb7t1nb4v2&doc.view=frames&chunk.id=div00026&toc.depth=1&toc.id>.

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

Estrin, Thelma Austern

b. 1924

Computer Scientist, Biomedical Engineer

Education: B.S., University of Wisconsin, 1948, M.S., 1949, Ph.D., electrical engineering, 1951

Professional Experience: researcher, Neurological Institute, Columbia Presbyterian Hospital, New York City, early 1950s; researcher, Weizmann Institute of Science, Israel, 1953–1955; research engineer, Health Science Center, University of California, Los Angeles (UCLA), 1960–1970, director, Data Processing Laboratory, Brain Research Institute, 1970–1980; director, Division of Electronic Computer and Systems Engineering, National Science Foundation, 1982–1984; professor of engineering, Computer Science Department, UCLA, 1980–1991,

assistant dean, School of Engineering and Applied Science, 1984–1991, director, Department of Engineering and Science Extension, 1984–1991, emeritus professor

Concurrent Positions: Fulbright fellow, Weizmann Institute of Science, Rehovot, Israel, 1963; principal investigator, U.S. Public Health Service grant, Data Processing Laboratory, Brain Research Institute, University of California, Los Angeles, 1970–1980, adjunct professor, anatomy and computer science, 1978–1980

Thelma Estrin is a biomedical engineer renowned for her research in the application of computer technology to neurophysiological research. Her work has been applied by medical researchers to create brain maps of patients based on external imaging and for identifying the epileptic foci in the brain. She was the first woman to be certified as a clinical engineer. She participated in designing and building the first computer in the Middle East at the Weizmann Institute of Science in Israel from 1953 through 1955, and she was one of the team leaders who designed and established the first general-purpose computer for brain research at UCLA in 1961.

She and her husband were history majors during World War II when they were recruited for the war effort. Her husband enlisted in the army and, after an intensive engineering assistant course at the Stevens Institute of Technology, Thelma was placed at a tool and model shop called Radio Receptor Company. After the war, both enrolled at the University of Wisconsin, where they obtained degrees in electrical engineering. Her husband, Gerald Estrin, went to Princeton to design and build the first digital electronic computing machine, but few universities were interested in hiring women as engineers in the 1950s. Thelma obtained a research position in the electroencephalography (EEG) Department of the Neurological Institute at Columbia Presbyterian Hospital in New York, conducting research on the electrical activity of the brain.

In 1953, Israeli scientists invited Gerald to build a version of his digital computer for the Weizmann Institute of Science, and Thelma participated in building the first computer in the Middle East. The couple returned to Los Angeles, where Gerald taught engineering at UCLA and Thelma was affiliated with the medical school, where she helped establish the first computer facility for brain research, called the Data Processing Laboratory, in 1961. Her work was funded by National Institutes of Health, and in 1970, Estrin was appointed director of the laboratory and principal investigator. She later designed an online analog-to-digital system and studied interactive graphics as a brain research tool. She eventually joined UCLA's School of Engineering and Applied Science, and one of her graduate students in the 1980s developed a microcomputer version of the concept of artificial intelligence (AI).

Estrin officially retired in 1991, but she remains very active in promoting the role of women in science and engineering, and mentoring younger women in their

careers. All three of Estrin's own daughters have excelled in the sciences; two are computer engineers and one is a physician. Estrin has served on numerous committees and as president of the Biomedical Engineering Society. She is a fellow of the Institute for Electrical and Electronics Engineers (vice president, 1992), and was inducted into the Women in Technology International (WITI) Hall of Fame (1999). She is a member of the Institute for the Advancement of Engineers, American Association for the Advancement of Science, Alliance for Engineering in Medicine and Biology, and Association for Computing Machinery. She received the Society of Women Engineers Achievement Award (1981) for her work in biomedical engineering.

Further Resources

University of California, Los Angeles. Faculty website. http://www.cs.ucla.edu/csd/people/faculty_pages/testrin.html.

Institute of Electrical and Electronic Engineers. "Oral History: Thelma Estrin." http://www.ieeeeghn.org/wiki/index.php/Oral-History:Thelma_Estrin.

Evans, Alice Catherine

1881–1975

Microbiologist

Education: B.S., Cornell University, 1909; M.S., bacteriology, University of Wisconsin, 1910

Professional Experience: public school teacher, 1901–1905; dairy bacteriologist, Bureau of Animal Industry, U.S. Department of Agriculture (USDA), staff, agricultural experiment station, Madison, Wisconsin, 1910–1913, bacteriologist, USDA, Washington, D.C., 1913–1918; U.S. Public Health Service, 1918–1945

Alice Evans was a microbiologist employed by the federal government, and her work on brucellosis is cited as one of the outstanding achievements in medical science in the early twentieth century. Working in the dairy division of the USDA, she studied the bacterial contamination of milk products. She led pioneering studies on the common origin of brucellosis in both cattle and humans. Prior to that, the assumption was that these were two separate diseases; the human form was called *undulant fever*. Many scientists and physicians would not accept her conclusions and refused to support her campaign for the pasteurization of milk. It was unthinkable that a pure product such as unpasteurized milk could cause disease,

and she was a woman scientist who did not have a doctorate or a medical degree. Transferring to the U.S. Public Health Service in 1918, Evans worked on epidemic meningitis, influenza, and streptococcal infections. By that time, her theories on brucellosis were gaining wide acceptance because human brucellosis was being reported throughout the world and from diverse animal sources. In the 1930s, the dairy industry was forced to begin pasteurizing all milk.

Evan taught public school for four years before enrolling in a nature study course for rural teachers at Cornell. She continued taking courses at Cornell to earn her undergraduate degree, then went on to receive her master's degree in bacteriology from the University of Wisconsin. She later received an honorary M.D. from the Woman's Medical College of Pennsylvania (1934) and an honorary doctorate from Wilson College (1936). In 1928, she became the first woman elected president of the Society of American Bacteriologists. In 1975, she was elected an honorary member of the American Society for Microbiology.

Further Resources

Burns, Virginia Law. 1993. *Gentle Hunter: A Biography of Alice Evans, Bacteriologist*. Laingsburg, MI: Enterprise Press.



Microbiologist Alice Evans identified the organism causing undulant fever, which led to laws mandating milk pasteurization. (National Library of Medicine)

F

Faber, Sandra (Moore)

b. 1944

Astronomer, Cosmologist

Education: B.A., Swarthmore College, 1966; Ph.D., astronomy, Harvard University, 1972

Professional Experience: assistant professor to professor and astronomer, Lick Observatory, University of California, Santa Cruz, 1972–

Concurrent Positions: Alfred P. Sloan Foundation fellow, 1977–; science advisory committee, National New Technology Telescope, 1983–1984; board of trustees, Carnegie Institution of Washington, 1985–; chair, Keck Telescope Science Steering Committee, 1987–1990; member, Hubble Space Telescope Strategy Panel, 1990, Users Committee, 1990, Wide-Field Camera Team, 1985–

Sandra Faber is known internationally for her research on the origin of the universe and of galaxies in particular, a special branch of astronomy called “cosmology.” She has discovered correlations between galaxies’ features—called *scaling laws*—that enable astronomers, having measured some features, to predict others. One of the more prominent, called “the Faber-Jackson law,” is that larger elliptical galaxies have stars that are orbiting more rapidly than those in smaller ones. She theorized that much of the matter in the universe is in the form of massive, invisible halos surrounding galaxies, and that this cold, dark matter has played a determining role in the origin and development of galaxies. Previously, scientists believed the universe was formed by hot matter.

Faber majored in physics and minored in mathematics and astronomy at Swarthmore College, where she was mentored by the renowned observatory director **Sarah Lee Lippincott**. The limited opportunities faced by Lippincott, who did not hold an advanced degree and was not a regular faculty member, inspired Faber to pursue the Ph.D. Faber went on to Harvard, then moved to Washington, D.C., where her husband had a job. She was able to use the computers at the Carnegie Institution’s Department of Terrestrial Magnetism to compile data for her thesis and received her Ph.D. in Astronomy from Harvard in 1972. The couple moved to California, where Faber obtained a position at the Lick Observatory at the

University of California, Santa Cruz. She was the first female faculty member at Lick, where she and Robert Jackson, a fellow graduate student, developed the Faber-Jackson scaling law. Faber and six associates formed a collaboration called the Seven Samurai in the 1980s. The team identified the Great Attractor, the nearest huge supercluster of galaxies, and estimated the distance of different galaxies by creating a map of all of the elliptical galaxies surrounding the Earth in space. Faber helped establish the Keck Observatory and 10-meter telescope at Mauna Kea, Hawaii, currently the largest optical telescope in the world. She was part of the team responsible for the Wide-Field Planetary Camera for the Hubble Space Telescope and helped diagnose the problem with the telescope's mirror and prepare a plan to fix it.

Faber was elected to membership in the National Academy of Sciences in 1985. She has received numerous prizes, such as the Bart J. Bok Prize of Harvard University (1978), the Heineman Prize of the American Astronomical Society (1986), a Harvard Centennial Medal (2006), and the Bower Award of the Franklin Institute (2009). Faber has been invited to give guest lectures throughout the world and is a member of the International Astronomical Union, American Astronomical Society, American Academy of Arts and Sciences, and the American Association for the Advancement of Science. Her research involves formation and evolution of normal galaxies, stellar populations in galaxies, galactic structure, stellar spectroscopy, cluster of galaxies, and cosmology. She has participated in several documentaries on public television, such as "Mysteries of Deep Space" (1997).

Further Resources

University of California, Santa Cruz. Faculty website. <http://www.ucolick.org/~board/faculty/faber.html>.

Farquhar, Marilyn (Gist)

b. 1928

Cell Biologist, Experimental Pathologist

Education: B.A., University of California, Berkeley, 1949, M.A., experimental pathology, 1953, Ph.D., experimental pathology, 1955

Professional Experience: junior research pathologist, University of California, 1953–1954; research assistant, anatomy, University of Minnesota Medical School, 1954–1955; assistant research pathologist, University of California, San Francisco, 1956–1958; research associate, cell biology, Rockefeller University,

1958–1962; associate research pathologist to professor, University of California, San Francisco, 1962–1970; professor, cell biology, Rockefeller University, 1970–1973; professor, cell biology and pathology, Yale University School of Medicine, 1973–1989; professor, pathology, Division of Cellular and Molecular Medicine, University of California, San Diego, 1990–

Marilyn Farquhar is a pioneer cell biologist who studies the mechanisms of renal disease and protein trafficking within cells. Her research has yielded a number of discoveries in basic biomedical research, including the mechanisms of kidney disease, the organization of functions that attach cells to one another, and the mechanisms of secretions—that is, the mechanisms by which cells produce and release their products.

She grew up in the central valley farmlands of California and majored in zoology before becoming one of only three women in her medical school class at the University of California, San Francisco. She became fascinated with the nature of diseases and shifted to a program in experimental pathology instead of obtaining a medical degree. She married another medical student in 1951 and also felt that research would allow more flexibility in raising a family. She was fortunate to work with a professor who had the only electron microscope in the entire medical center, allowing her to be involved in the very beginning of applications of electron microscopy in the new field of cell biology.

After receiving her Ph.D., she conducted kidney research at the University of Minnesota and then Rockefeller University, where she joined the laboratory of George Palade, the most active and productive team working in cell biology in the country. She took a faculty position in San Francisco for eight years before returning to Rockefeller as a professor of cell biology, the only woman professor at the institution. She divorced her first husband and married George Palade in 1970. The couple moved to Yale University School of Medicine in 1973 as full professors to start a new department of cell biology. In 1974, Palade received the Nobel Prize in Physiology or Medicine for his discovery of ribosomes, the cell organ that synthesizes proteins. In 1990, both were actively recruited to move to the University of California, San Diego, where they started and became co-directors of the new Division of Cellular and Molecular Medicine in the Medical School.

Farquhar was elected to membership in the National Academy of Sciences in 1984. She has received numerous honors and awards, including the E. B. Wilson Medal of the American Society for Cell Biology (1987), the Homer Smith Award of the American Society of Nephrology (1988), the Distinguished Scientist Medal of the Electron Microscopy Society of America (1987), the National Institutes of Health Merit Award (1988), and the Federation of American Societies of Experimental Biology (FASEB) Award for Excellence in Science (2006). She is a

member of the American Academy of Arts and Sciences, American Society for Cell Biology (president, 1981–1982), American Association of Pathologists, American Association of Anatomists, American Society of Nephrology, Endocrine Society, and Histochemical Society.

Further Resources

University of California, San Diego. Faculty website. <http://cmm.ucsd.edu/farquhar/index.html>.

Farr, Wanda Kirkbride

1895 1983

Cytologist

Education: B.S., Ohio University, Athens, 1915; A.M., Columbia University, 1918

Professional Experience: assistant, botany, Ohio University, 1915–1916; instructor, Kansas State College, 1917–1918; instructor, Agricultural and Mechanical College of Texas, 1918–1919; research associate, Barnard Free Skin and Cancer Clinic, St. Louis, 1926–1927; instructor, Shaw School of Botany, St. Louis, 1928; investigator, plant physiology, Boyce Thompson Institute, 1928–1929; associate cotton technologist, U.S. Department of Agriculture (USDA), 1929–1936; director, Cellulose Laboratory, Chemical Foundation, Boyce Thompson Institute, 1936–1940; research chemist, American Cyanamid Company, 1940–1943; Research Division, Celanese Corporation of America, 1943–1954; Marie Curie lecturer, Pennsylvania State University, 1954–1955; research consultant, 1956–1983

Concurrent Positions: associate professor, botany and cytochemistry, University of Maine, consultant, 1957–1960

Wanda Farr discovered the source for cellulose in research she and her first husband had started several years previously. She had planned to study medicine when she attended college, but her family refused to permit it because her health was somewhat frail. She then decided to study science and focus on research. She completed her undergraduate degree in three years and went to Columbia University for her master's degree. There she met Clifford Farr, who was completing his doctorate. She interrupted her master's program to teach at Kansas State while he was teaching at Texas A&M. After their marriage, the couple moved to Washington, D.C., where he was on special assignment to the USDA during

World War I. She obtained a position in the botany department when they returned to Texas, and when they moved to St. Louis, she obtained a position at the Barnard Free Skin and Cancer Clinic, where she assisted in research on living cells of animal organisms.

When her husband died in 1928, she was invited to continue his university botany classes even though she did not hold a doctorate. She was, however, familiar with his work, and she was able to continue their research on root hairs of plants under her own name. Some contemporaries questioned the originality of her contributions due to her taking over her husband's work, but she was able to secure important grants and move on to other employment based on her own merits. After working briefly for Boyce Thompson, Farr moved to the USDA to perform research on cotton. This research applied to her individual project on root hairs, which led to her discovery of the source for cellulose. She later obtained significant appointments at Boyce Thompson and two chemical companies, American Cyanamid and Celanese Corporation, and started her own research firm, Farr Cytochemical Laboratories, in 1956. Farr was elected a fellow of the Royal Microscopical Society and was a member of professional societies such as the Botanical Society of America and the Torrey Botanical Club.

Fausto-Sterling, Anne

b. 1944

Embryologist

Education: B.A., University of Wisconsin, 1965; Ph.D., developmental genetics, Brown University, 1970

Professional Experience: instructor, medical science, Brown University, 1971–1972; assistant professor to professor, Division of Biology and Medicine, Brown University, 1972–

Concurrent Positions: visiting professor, University of Amsterdam, 1986

Anne Fausto-Sterling researches biological theories about women from the perspective of the formation, development, structure, and functional activities of embryos. As a scientist and a feminist, she criticizes those who link biology to gender assumptions, such as the myths that sex-related hormones control one's destiny as a man or a woman, assumptions that females possess an inherently inferior ability to perceive spatial relations among objects, or that hormonally induced mood fluctuations affect a woman's ability to function in society. Fausto-Sterling argues that the political goal to relegate women to subordinate positions within society

has influenced much of the research conducted in both biology and genetics. In 1985, she published *Myths of Gender: Biological Theories about Women and Men*, in which she raised doubts about the validity of scientific studies that support traditional gender roles, pointing out the underlying social biases, inadequate evidence, and faulty methods in scientific research on sex differences. An updated edition of the book was published in 1992 to include new research on the brain and homosexuality. Her work has, not surprisingly, generated controversy and criticism.

Fausto-Sterling received her doctorate from Brown University in 1970 and has remained at Brown as a faculty member since that time. Her initial research was based on *Drosophila*, the fruit fly, and on the evolution and regeneration of freshwater flatworms called *Planaria*. She discovered these flatworms have five different modes of reproduction, three asexual and two sexual. She became aware of gender bias even in scientific studies of animals and began to examine the research on human reproduction and sexuality. Many of her articles and books have reached a mainstream audience. Her essay on “The Five Sexes” was an honorable mention among *The Best American Essays of 1994*. Among her other works is the book *Sexing the Body: Gender Politics and the Construction of Sexuality* (2000).

She has received many honors, including a National Science Foundation grant (1971) and a Wellesley Center for Research on Women Mellon fellowship (1980–1981). She was a fellow of Pembroke Center for Research and Teaching on Women (1982) and is a member of the American Association for the Advancement of Science, the Society for Developmental Biology, and the International Society for Developmental Biology.

Further Resources

Ambrose, Susan A. et al. 1997. *Journeys of Women in Science and Engineering: No Universal Constants*. Philadelphia, PA: Temple University Press.

Brown University. Faculty website. http://bms.brown.edu/faculty/f/afs/afs_home.html.

Fedoroff, Nina Vsevolod

b. 1942

Molecular Biologist

Education: B.S., Syracuse University, 1966; Ph.D., molecular biology, Rockefeller University, 1972

Professional Experience: assistant professor, biology, University of California, Los Angeles, 1972–1974, Damon Runyan-Walter Winchell Cancer Research Fund Fellow in molecular biology, School of Medicine, 1974–1975; professor, biology,

Johns Hopkins University, 1979–1994; director, Biotechnical Institute, Pennsylvania State University, 1995–, professor, life sciences, 1995–

Concurrent Positions: National Institutes of Health fellow, Carnegie Institution of Washington, 1975–1977, research associate, 1977–1978, staff scientist, 1978–1994.

Nina Fedoroff is renowned for her success in duplicating and analyzing the transposable genetic elements in maize (corn) first identified by the American geneticist **Barbara McClintock**. After meeting McClintock at a conference, Fedoroff became so intrigued with the idea of transposable elements that she not only replicated McClintock's work but also discovered that the transposable elements were mobile in plants other than maize. Other molecular biologists quickly picked up



Molecular biologist Nina Fedoroff receiving the National Medal of Science from President George W. Bush, 2007. (AP/Wide World Photos)

the system of cloning from her work and used the maize transposable elements to mark and clone genes in other plants. She is the author of the book *Dynamic Genome: Barbara McClintock's Ideas in the Century of Genetics* (1992).

While still an undergraduate, Fedoroff received a National Science Foundation grant to spend the summer at Woods Hole Marine Biological Laboratory, where she was inspired to pursue scientific research. After receiving her Ph.D. in Molecular Biology, she taught classes and conducted research on ribonucleic acid (RNA) under cancer research grants and a fellowship from the National Institutes of Health (NIH). Her early work on the replications of viruses that destroy bacteria shed light upon ribosomes, the principal sites of protein synthesis. She then turned to cloning and molecular genetic analysis of maize transposable elements. These elements, known as “jumping genes,” were of interest because of their ability to move to new positions on the chromosome. Her work has contributed substantially to the development of the entire field of plant molecular biology and to debates about introducing genetically engineered organisms into the environment. In 2004, she co-authored with Nancy Marie Brown the book *Mendel in the Kitchen: A Scientist's View of Genetically Modified Foods*.

Fedoroff was elected to membership in the National Academy of Sciences in 1990 and was honored by the New York Academy of Sciences as an outstanding woman scientist in 1992. The U.S. government has acknowledged her work with a 2006 National Medal of Science, and in 2007, Secretary of State Condoleezza Rice named Fedoroff a national science and technology advisor. She has been a member of the Science Advisory Panel on Applications of Genetics, Office of Technological Assessment, U.S. Congress, the NIH Recombinant DNA Advisory Committee, and the Council on Life Science and Board of Basic Biology. She is a member of the American Academy of Arts and Sciences and the American Association for the Advancement of Science.

Further Resources

Pennsylvania State University. Faculty website. <http://www.lsc.psu.edu/lsc/fedoroff.html>.

Ferguson, Angela Dorothea

b. 1925

Pediatrician

Education: B.S., Howard University, 1945, M.D., 1949

Professional Experience: instructor, pediatrics, Howard University School of Medicine, 1953–1959, associate pediatrician, Freedmen's Hospital, 1953–1970,

assistant professor, 1959–1963, professor, 1963–1990, head, University Office of Health Affairs, 1970–1979, associate vice president for health affairs, 1979–1990

Concurrent Positions: staff member, District of Columbia General Hospital, 1963–1990

Angela Ferguson has been recognized for her research on the symptoms and treatment of sickle-cell anemia, a hereditary disease that overwhelmingly affects people of African descent. She was born in Washington, D.C., and although her father was a public school teacher, the family lived on the edge of poverty. In elementary school, she worked in the cafeteria in exchange for her school meals. In high school, she first focused on business courses because she felt she would be unable to attend college, but by her second year of high school, she had discovered that she liked science and math courses and that she was intelligent enough to do well in them. She enrolled in Howard University so she could live at home while attending school. Her parents paid her tuition the first year, but she received scholarships after that. By the second year of college, her interests had shifted from chemistry and mathematics to biology, and she began considering medical school. She wanted to become both a researcher and a physician. In medical school, she majored in pediatrics, which involves the treatment of infants and young children.

After completing her residency, she started a private pediatrics practice, but she found that she was unable to answer parents' questions about their children because all research on developmental physiology had been conducted on children with European backgrounds, not on African American children. She obtained a research position at Howard University's School of Medicine and its teaching hospital, Freedmen's Hospital, to gather data on the physiology of children from the well-baby clinics around the United States. The data on height and weight from these records could be used to estimate the expected size at each age level. In examining the records, she found that a large number of black children suffered from sickle-cell anemia, a hereditary disease that causes red blood cells to function improperly. Healthy red blood cells are doughnut-shaped, but diseased red blood cells are folded into a sickle shape, which affects the easy flow of blood in veins and arteries.

In attempting to develop a method for detecting the disease in young children, Ferguson found that the early symptoms closely resemble many other medical conditions. In infants, the symptoms resemble those of arthritis; between the ages of 2 and 6, the symptoms look like a shortage of certain vitamins in the diet; between 6 and 12 years, most children show no symptoms or only very mild ones; and after 12 years of age, the disease can return, with the most common symptom being skin ulcers. She started giving each newborn infant a blood test to detect the

condition at the earliest possible time. If a patient required surgery, he or she could be given oxygen after coming out of the anesthesia. For five-year-olds, the severe symptoms could be reduced by drinking water with baking soda on a daily basis.

In the 1960s, she decided to shift her focus to administrative work. She was instrumental in developing plans to build a new teaching hospital, one that included a children's wing, to replace the outdated Freedmen's Hospital. In 1970, she was appointed to be in charge of the University Office of Health Affairs, which included responsibility for facility development, student health services, research, and advanced instruction for all degree programs at the Howard University Medical School. The new Freedmen's Hospital opened in 1975, and in 1979, she was named the associate vice president for health affairs.

Among her awards are two Certificates of Merit from the American Medical Association. She is a member of the Society for Pediatric Research, Society of Nuclear Medicine, National Medical Association, and New York Academy of Sciences.

Ferguson, Margaret Clay

1863 1951

Botanist

Education: student, Wellesley College, 1889–1891; B.S., Cornell University, 1899, Ph.D., botany, 1901

Professional Experience: public school teacher and principal, 1877–1888; private school teacher, 1892–1893; instructor, botany, Wellesley College, 1894–1896, 1901–1904, associate professor, 1904–1906, head of botany department, 1904–1930, research professor, 1930–1932

Concurrent Positions: director, botany greenhouses and gardens, Wellesley, 1922–1932

Margaret Ferguson was recognized as one of the most productive women botanists of her time. As head of the department at Wellesley, she trained more women botanists than anyone else. After teaching school and obtaining a limited amount of education, she became a special student at Wellesley in botany and chemistry. She taught school again before returning to Wellesley as an instructor in botany. She completed her formal education at Cornell, receiving her doctorate in 1901. In her research at Cornell, she initiated important work on the reproductive process and life history of a species of native pine (*Pinus strobes*).

Her research was published in the *Proceedings of the Washington Academy of Sciences* in 1904 and gained wide attention. The study was one of the first to give a detailed analysis of the functional morphology and cytology of a pine native to North America. Returning to Wellesley in 1901, she rose in rank to professor and head of the department in 1904. As department head, she helped make it one of the leading undergraduate centers in the nation for the study of plant science. She emphasized laboratory work and added coursework in chemistry, physics, and zoology to botanical studies. She also helped build the plant specimen collection and the science library at Wellesley. She was able to combine research with her teaching and administrative responsibilities and to secure funds to build new college greenhouses and a botany building, allowing space for students to grow their own plants and conduct experiments. During the 1920s, the focus of her research and advanced courses shifted to genetics, helping to classify previously confused horticultural varieties. She discovered that flower color and pattern were not necessarily hereditary traits, findings that would not be confirmed by other researchers until the 1970s. Although she officially retired in 1932, she continued her research under a grant from the National Research Council and was able to present her work at the Sixth International Congress of Genetics.

Ferguson was elected vice president of the American Microscopical Society in 1914, and was elected the first female president of the Botanical Society of America in 1929. She was elected a fellow of the New York Academy of Sciences in 1943 and was also a fellow of the American Association for the Advancement of Science. She received an honorary degree at Mount Holyoke College's centennial in 1937. Wellesley honored her by naming for her the greenhouses that she had designed and directed.

Fink, Kathryn Ferguson

1917–1989

Biochemist

Education: B.A., University of Iowa, 1938; Ph.D., biochemistry, University of Rochester, 1943

Professional Experience: research technician, Mayo Institute of Experimental Medicine, 1938–1939; research associate, Manhattan Project, University of Rochester, 1943–1946, Atomic Energy Project, 1946–1947; associate clinical professor, biophysics, School of Medicine, University of California, Los Angeles (UCLA),

1948–1963, associate research professor, biophysics and nuclear medicine, 1964–1966, professor, 1966–1967, professor of medicine, 1967–1989, assistant dean, 1976–1989

Concurrent Positions: research biochemist, Veterans Administration Hospital, 1947–1961

Kathryn Fink was a pioneer in the field of nuclear medicine. After receiving her doctorate in biochemistry from the University of Rochester in 1943, she held a National Research Council fellowship to work on the Manhattan and Atomic Energy Projects during World War II. The Manhattan Project proved to be a boon to the careers of numerous women scientists, since the federal government's accelerated program to develop atomic power required huge scientific staffs. It also saw the creation of the field of nuclear medicine. After the war, Fink moved to California as a faculty member in biophysics and nuclear medicine at the UCLA School of Medicine. For many years, she held a joint appointment as a researcher at the Veterans Administration Hospitals in Van Nuys and then Long Beach. In 1967, she was the first Ph.D. (instead of M.D.) to be appointed full professor of medicine at the UCLA medical school. She served as an assistant dean of student affairs at the school during the last decade of her career.

Fink published numerous scientific papers in collaboration with her husband, Robert Fink, a professor of biological chemistry. Fink was named UCLA Woman of Science (1971) and *Los Angeles Times* Woman of the Year in Science (1971). She was a member of the Society for Experimental Biology and Medicine, and the American Society of Biological Chemists.

Further Resources

University of California. "Kathryn Ferguson Fink, Medicine: Los Angeles." <http://content.cdlib.org/xtf/view?docId=hb4p30063r&doc.view=frames&chunk.id=div00017&toc.depth=1&toc.id=>

Fischer, Irene (Kaminka)

1907–2009

Geodesist, Mathematician

Education: M.A., mathematics, University of Vienna; M.A., descriptive geometry, Vienna Institute of Technology, 1931; postgraduate study, University of Virginia and Georgetown University, 1950–1957

Professional Experience: secondary school teacher, mathematics, description geometry, and engineering drawing, Vienna, Austria, 1931–1938; researcher, Massachusetts Institute of Technology (MIT), 1942–1944; mathematician, Geodesy Branch, U.S. Army Map Service, 1952–1958, geodesist, 1958–1962, supervisory geodesist, 1962–1965, supervisory research geodesist, 1965–1977, branch chief, 1962–1977

Concurrent Positions: teacher, various secondary schools and colleges, United States, 1941–1945

Irene Fischer was an expert in her field, although much of her research was classified as military secrets. She was a mathematician and geodesist, a scientist who deals with the measurement of the shape and area of large tracts of country, the exact positions of geographical points, and the curvature, shape, and dimensions of the Earth. Born and educated in Austria, her family fled the Nazis and came to the United States during World War II. She taught mathematics at a variety of schools and colleges before taking a research position at MIT. After two years at MIT, she obtained a position as a mathematician with the U.S. Army Map Service (later the Defense Mapping Agency Topographic Center), where she held research and supervisory positions. She contributed data used for the Mercury, Gemini, and Apollo projects, which were among the first experimental flights conducted by the National Aeronautics and Space Administration (NASA). NASA required precise topographical data on both the Earth and the seas in order to plan and execute these experimental flights.

Fischer wrote two books, *Geometry* (1965) and *Basic Geodesy: The Geoid—What's That?* (1973), in addition to hundreds of articles in professional journals and a self-published memoir, *Geodesy: What's That? My Personal Involvement in the Age-Old Quest for the Size and Shape of the Earth* (2005). In the 1950s and 1960s, she published a series of papers in the *Journal of Geophysical Research* on work conducted at the Defense Mapping Agency on the geoid, an imaginary surface that coincides with mean sea level in the ocean and its extension through the continents. In the 1970s, she published papers on bathymetry, which is the measurement of the depth of oceans, and marine geodesy. During her years of employment at the agency, she was involved in using all of the new technology, from the introduction of computers to satellite observations. In 1969, she was a member of the committee that compiled South American data for the Pan-American Institute of Geography and History. She was also a member of the special study group on the history of geodesy for the International Association of Geodesy. Much of Fischer's early work was conducted before the use of satellites, which would later confirm her models and measurements.

Fischer was elected to membership in the National Academy of Engineering in 1979. Among the awards she received were the Meritorious Civilian Service Award, Department of the Army (1957), the Bronze Leaf Cluster (1966), the Research and Development Achievement Award (1966), a Decoration for Exceptional Civilian Service (1967); the Distinguished Civilian Service Award, Department of Defense (1967), Outstanding Career Woman, Defense Mapping Agency (1975), the Meritorious Service Medal (1977), a National Civil Service League Career Award (1976), and the designation of Federal Retiree of the Year (1978). She was a fellow of the American Geophysical Union, a member of the International Association of Geodesy, and inducted into the National Imagery and Mapping Agency Hall of Fame. Fischer lived to be 102 years old.

Further Resources

Straight, Wendy J. W. 2005. "Irene K. Fischer, Geodesist." Newsletter No. 2/05, Joint Commission Working Group on Under-Represented Groups in Surveying, International Federation of Surveyors. http://www.fig.net/pub/underrep_news/200502/newsletter200502.htm#Irene.

Fisher, Anna L.

b. 1949

Physician, Astronaut

Education: B.S., chemistry, University of California, Los Angeles, 1971, M.D., 1976, M.S., chemistry, 1987

Professional Experience: emergency room physician, Los Angeles area hospitals, 1977–1978; mission specialist, National Aeronautics and Space Administration (NASA), 1978–1979, astronaut, 1980–1989, Chief, Operations Planning/Training, Space Station Branch, 1997–1998, Deputy, Operations/Training, Space Station Branch, 1998–1999, Chief, Space Station Branch, Astronaut Office

Anna Fisher was one of the first group of women astronauts selected in 1978 and has the distinction of being the first mother to fly in space. She decided at age 13 that she would like to be an astronaut, and began by pursuing a career in medicine. She earned her medical degree and was working as an emergency room specialist when NASA announced that a new group of astronauts with revised requirements would be selected. She and her then-fiancé both applied for admission to the program; a week after she married William F. Fisher (who was selected for the astronaut program in 1980), she found out she was chosen. Her duties as an

astronaut included developing and testing the Remote Manipulator System (RMS), verifying flight software, and providing medical backup in rescue helicopters. She and her husband served as emergency physicians for a number of the launchings and landings, and she was on-orbit capsule communicator for the STS-9 mission. Her first space flight was on November 8, 1984, on the second flight of the orbiter *Discovery*, which she flew when her first child was barely one year old. The crew accomplished the first space salvage in history, retrieving the Palapa B-2 and Westar VI satellites. In her later work in the Space Station Support Office, she became the crew representative for space-station development training, operations concepts, and health maintenance. She also tested a shuttle-tile repair kit in which epoxy was sprayed into the place of a lost or broken thermal tile—which proved to be unnecessary after the first and second flights of *Columbia*. She helped Martin-Marietta test and develop the manned maneuvering unit (MMU), the rocket-powered backpack that allows an astronaut to propel himself or herself around while wearing a space suit.

Between 1989 and 1996, Fisher took a leave of absence from NASA to focus on raising her family before returning to a position in the Operations Planning Branch in support of the International Space Station and then as deputy for procedures and training of astronauts and engineers related to the Space Station Program. Fisher has also worked in the Shuttle Branch and awaits assignment to either a shuttle mission or to the International Space Station. She is the recipient of a NASA Space Flight Medal, Lloyd's of London Silver Medal for Meritorious Salvage Operations, University of California, Los Angeles (UCLA) Professional Achievement Award, UCLA Medical Professional Achievement Award, and NASA Exceptional Service Medal (1999).

Further Resources

Kevles, Bettyann H. 2003. *Almost Heaven: The Story of Women in Space*. New York: Basic Books.



Astronaut Anna Fisher prepares for training, 1980. (NASA)

National Aeronautics and Space Administration. "Anna L. Fisher, (M.D.)." <http://www.jsc.nasa.gov/Bios/htmlbios/fisher-a.html>.

Fitzroy, Nancy (Deloye)

b. 1927

Engineer

Education: B.ChE., Rensselaer Polytechnic Institute, 1949

Professional Experience: assistant engineer, Knolls Atomic Power Laboratory, 1950–1952; development engineer, Hermes Missile Project, General Electric Company, 1952–1953, development engineer, 1953–1963, heat transfer engineer, Advanced Technology Laboratories, 1963–1965, consultant in heat transfer, Research and Development Center, 1965–1971, manager, heat transfer consulting, 1971–1974, strategy planner, 1974–1976, advanced concepts planner and proposal manager, 1976–1979, program development manager, Gas Turbine Division, 1979–1982, manager, energy and environment programs, Turbine Market and Projects Division, 1982–1987; consultant in fields of gas turbines, nuclear energy, and space vehicles, 1987–

Nancy Fitzroy is known for her research in the properties of materials, heat transfer, and fluid flow that she conducted at General Electric Company, where she worked for more 30 years. She was first assigned to a team to solve a thorny heat transfer problem: how to keep the high temperatures produced by an atomic reaction from escaping the nuclear reactor of an atomic generator or a nuclear submarine. Later she worked on keeping the delicate electronic equipment in space satellites at room temperature while the skin of the satellite was being alternately superheated and supercooled. She has also designed more standard consumer-type products such as toasters and microwave ovens. She says that toasters can present more problems than missiles and satellites because outer space is basically uniform, but no two pieces of bread are alike.

Fitzroy was one of the first to study heat transfer surfaces in nuclear-reactor cores, and she holds a patent in the area of cooling integrated circuits, having invented a thermal chip that is used to measure temperatures in such circuits. She also developed a thermal protection system for hardened radar antennae that was used in the U.S. early-warning system. Her work reflects the interdisciplinary nature of engineering, as she can be considered both a chemical and a mechanical engineer. In the 1970s, she took on more administrative and management responsibilities at GE. She taught in the GE employee Advanced Engineering Course and

is the author of the *GE Heat Transfer and Fluid Flow Data Books* (1955–1974), which were used throughout industry and academia.

Fitzroy was elected to membership in the National Academy of Engineering in 1995. She received the Achievement Award of the Society of Women Engineers (1972), the Federation of Professional Women Award (1984), the Demers Medal of Rensselaer Polytechnic Institute (1975), and the Centennial Medallion of the American Society of Mechanical Engineers (1980). In 1999, she was inducted into the Rensselaer Polytechnic Institute Alumni Hall of Fame. She was, in fact, the first female chemical engineering student at Rensselaer, and her alma mater later acknowledged her with an honorary doctorate. She helped establish the Nancy Fitzroy Scholarship Fund for female students in science and technology. She is a fellow of the American Society of Mechanical Engineers and was the first female president of that organization (1986–1987). She was also a member of the American Institute of Chemical Engineers, National Society of Professional Engineers, and Society of Women Engineers.

Flanigen, Edith Marie

b. 1929

Inorganic Chemist

Education: B.A., D'Youville College, 1950; M.S., Syracuse University, 1952

Professional Experience: research chemist, Union Carbide Corporation, 1952–1960, senior research chemist, 1960–1962, research associate, 1962–1967, senior research associate, 1967–1969, senior research scientist, 1969–1973, corporate research fellow, 1973–1982, corporate senior research fellow, 1982–1988; senior research fellow, UOP, Inc. (Union Carbide-Allied Signal joint venture), 1988–1994; consultant, UOP, 1994–

Edith Flanigen is renowned for her research on synthetic molecular sieves and synthetic zeolites, which are used in industry as catalysts. Molecular sieves are compounds with molecule-size pores, such as sodium aluminum silicate; zeolites are hydrated silicates of aluminum with alkali metals. In the 1970s, she developed a synthetic emerald for industrial use. Lincoln Laboratory had contracted with Union Carbide, where Flanigen was employed as a research chemist, to make synthetic emeralds for masers, which were microwave forerunners of lasers. Although zeolites are found in nature, scientists, including Flanigen, have found ways to make naturally and nonnaturally occurring structures by heating aqueous alumina-silica gels at 100 degrees Celsius to 450 degrees Celsius.

Flanigen devised a process to make emeralds by using temperature and pressure to control the different solubilities of aluminum, silicon, beryllium, and chromium oxides in aqueous gels. Union Carbide later marketed these as synthetic gemstones for use in jewelry.

Flanigen was first introduced to chemistry in high school, and she and her two sisters all majored in chemistry at D'Youville College. All three sisters eventually worked at Union Carbide. Edith Flanigen invented or co-invented more than 200 new synthetic materials and holds more than 100 U.S. patents. Her work has also had environmental applications in water purification and oil refining, and in 2004, she was inducted into the National Inventors Hall of Fame. Flanigen advanced through the researcher ranks at Union Carbide and, in 1982, was named a corporate senior research fellow, the first woman to achieve that distinction. In 1983 she received an honorary doctorate from her alma mater, D'Youville College.

Flanigen was elected to membership in the National Academy of Engineering in 1991 and has received two of the primary awards in chemistry: the Perkin Medal of the Society of Chemical Industry (1992, the first woman to receive that award), the Garvan-Olin Medal of the American Chemical Society (1993), International Zeolite Association Award (1994), and the Lemelson-MIT Lifetime Achievement Award (2004). She is a member of the Mineralogical Society of America, American Chemical Society, and American Association for the Advancement of Science.

Further Resources

Massachusetts Institute of Technology. "Edith Flanigen: 2004 Lemelson-MIT Lifetime Achievement Award Winner." <http://web.mit.edu/invent/a-winners/a-flanigen.html>.

Flugge-Lotz, Irmgard

1903–1974

Engineer

Education: Diplom Ingenieur, Hannover Technische Hochschule, 1927, Doktor Ingenieur, 1929

Professional Experience: junior research engineer to department head, Theoretical Aerodynamics, Aerodynamische Versuchsanstalt, Göttingen, 1929–1938; consultant, aerodynamics and dynamics of flight, Deutsche Versuchsanstalt für Luftfahrt, 1938–1945; chief, research group in theoretical aerodynamics, National Office for Aeronautical Research, France, 1946–1948; lecturer, engineering mechanics and research supervisor, Stanford University, 1949–1960, professor, aeronautical engineering and engineering mechanics, 1960–1968

Irmgard Flugge-Lotz was among the world's leading authorities on fluid mechanics. She received international recognition for her many important mathematical contributions to aerodynamics and automatic control theory. She began her career at an aerodynamics research institute in Germany cataloging reprints. After she developed an equation for one of her bosses, she was appointed head of a group dealing with theoretical dynamics. The work she performed in 1931 on the lifting force of wings of various shapes, known as the Lotz method, was recognized as a fundamental contribution throughout her lifetime. The only other women on the staff were "computers" who performed calculations for research engineers. After she married Wilhelm Flugge, an authority on thin-shell construction, in 1938, they moved to Berlin and both worked for Deutsche Versuchsanstalt für Luftfahrt. There she conducted research on electronic automatic control theory that had implications for development of simple automatic flight-control equipment for aircraft. Although they were known to have anti-Nazi views, they survived the war due to their scientific expertise. When Germany collapsed in 1945, the Flugges found work for the National Office for Aeronautical Research in Paris for two years and then emigrated to the United States for faculty positions at Stanford.

Although there were few graduate students who were interested in fluid dynamics, from nearby Ames Research Center, Flugge-Lotz drew a large group of research engineers who were working toward advanced degrees from Stanford. She developed another new area of research in the theory of automatic controls, a topic she had first investigated in the 1940s. In 1960, she was the only woman delegate from the United States at the First Congress of the International Federation of Automatic Control in Moscow, an honor that resulted in her appointment as full professor. After her retirement from teaching, she continued her research on problems of satellite control, heat transfer, and draft of high-speed vehicles.

In 1971, Flugge-Lotz became the only woman ever to be selected to present a von Karman Lecture, which is sponsored by the American Institute of Aeronautics and Astronautics. She also was the first woman to reach a full professorship in the engineering college at Stanford. In addition to more than 50 technical papers, she published two books: *Discontinuous Automatic Control* (1953) and *Discontinuous and Optimal Control* (1958). The American Institute of Aeronautics and Astronautics in 1970 elected her a fellow, only the second woman to be so honored. She also was a member of the Institute of Electrical and Electronics Engineers and the Society for Industrial and Applied Mathematics.

Further Resources

Agnes Scott College. "Irmgard Flugge-Lotz." Biographies of Women Mathematicians. <http://www.agnesscott.edu/lriddle/women/lotz.htm>.

Fossey, Dian

1932 1985

Primatologist, Zoologist, Anthropologist

Education: B.A., occupational therapy, San Jose State College, 1954; Ph.D., Cambridge University, 1976

Professional Experience: occupational therapist, Kosair Crippled Children's Hospital, Louisville, Kentucky, 1955–1966; scientific director, Karisoke Research Centre, Ruhengeri, Rwanda, 1967–1980 and 1983–1985

Concurrent Positions: visiting associate professor, anthropology, Cornell University, 1980–1982

Dian Fossey was the international authority on the mountain gorilla at the time of her death in 1985. One of the unsolved mysteries in science is who murdered her at her research station in Rwanda. Fossey attracted controversy for her work in politically unstable areas and, while several people or groups were suspected, there was only a cursory investigation by the understaffed Rwanda police. One of her



Primatologist Dian Fossey plays with a group of young mountain gorillas in Rwanda, 1982. (AP/Wide World Photos)

associates and several native employees were accused of the crime, but the consensus is that she was targeted by poachers angry over her efforts to protect gorillas. She was buried on the mountain in the graveyard that she had established for her gorillas.

Fossey had a lifelong interest in animals. She enrolled in the preveterinary medicine program at the University of California, Davis, but transferred to San Jose State after two years and earned a degree in occupational therapy. She realized her dream to see the gorillas that the primatologist George Schaller had described in his book, *The Mountain Gorilla: Ecology and Behavior* (1963), when she took out a three-year bank loan in 1963 for \$8,000 to finance a seven-week safari. Her first stop was the Olduvai Gorge in Tanzania to visit renowned archaeologists and anthropologists Louis and Mary Leakey. Fossey also stopped in the Congo (or Zaire) to see the mountain gorillas and returned to the United States to continue her work, pay off the loan, and keep up contacts with Leakey.

Fossey became known as one of “Leakey’s Ladies”—along with Jane Goodall and Birute Galdikas—all of whom were mentored by Louis Leakey and conducted research on the three major primate groups—gorillas, chimpanzees, and orangutans, respectively. The three women did not work together (and only met as a group three times over the course of their careers), but collectively changed the way primatologists conduct research by studying animals as individuals with life histories, as humans are studied. Leakey and Fossey were interested in not only sponsoring research on gorillas but also protecting them from further encroachments. Leakey offered Fossey a position with this project in 1966 in Zaire. When civil war broke out in that region, the rebels sought to expel all Westerners, and Fossey was held prisoner for several weeks until she escaped across the border into Uganda. Leakey helped her reestablish a center in Rwanda’s Parc National des Volcans, a remote area in a high rain forest. Here Fossey developed a unique research methodology: Rather than observing the animals from a distance, she gradually habituated them to her presence by imitating their sounds and behavior.

Her research was funded by the Leakey Foundation, the Wilkie Foundation, and the National Geographic Society. Leakey arranged for her to attend Cambridge University to complete her doctorate, as her work was attracting international attention. She began training graduate students in 1970 to see her gorillas. She accepted graduate students starting in 1970, and her group prepared a census of the gorilla population in 1981, indicating the number had declined 50% since Schaller’s 1963 book that first inspired Fossey. She became increasingly focused on protecting the gorillas and their habitat, making her the enemy of local poachers and farmers. In 1980, she accepted a visiting associate professorship at Cornell University, where she wrote her book *Gorillas in the Mist* (1983). When she returned to the research station, she continued her war against the poachers and farmers until she was murdered in 1985.

Fossey received the Franklin Burt Award from the National Geographic Society (1973) and the Joseph Wood Krutch Medal from the Humane Society of the United States (1984), and in 1988, her book, *Gorillas in the Mist*, was made into a feature film starring Sigourney Weaver, now the Honorary Chairperson of the Dian Fossey Gorilla Fund International. There are numerous books about Fossey's life and work.

Further Resources

The Dian Fossey Gorilla Fund. <http://www.gorillafund.org/>.

Fowler-Billings, Katharine Stevens

1902–1997

Geologist

Education: A.B., geology and biology, Bryn Mawr College, 1925; M.A., University of Wisconsin, 1926; Ph.D., geology, Columbia University, 1930

Professional Experience: geologist/pro prospector, Maroc Gold Company, Africa, 1931–1932; instructor, geology, Wellesley College, 1935–1938; instructor, geology, Erskine Junior College, Boston, 1941; instructor, geology, Tufts College, 1942–1943; geologist, New Hampshire Planning and Development Commission, 1943–1944; associate geologist, New England Museum of Natural History, 1940–1947; private research, 1947–1997

Katharine Fowler-Billings was one of a handful of women employed as a field geologist and explorer in the first half of the twentieth century, and her research spanned the globe. While pursuing her master's degree at the University of Wisconsin, she conducted research in the Black Hills and Glacier National Park. After receiving her Ph.D. from Columbia in 1930, she divided her time between teaching appointments and research expeditions to collect data for geological mappings, studying the anorthosites of the Laramie Mountains, Wyoming (the subject of her doctoral thesis); iron ores and molybdenite in Sierra Leone, West Africa; and the geology of the Cardigan Quadrangle of New Hampshire, Monadnock, and Mount Washington regions. While attending the International Geological Congress in South Africa in 1929, she met and married her first husband, James Lunn, also a geologist. When she was forbidden by local authorities to accompany Lunn to the Gold Coast of West Africa, she went anyway. She wrote a book about her adventures in *Gold Missus: A Woman Prospector in Sierra Leone* (1938). She also encountered sexism in the United States and had to disguise herself as a boy in order to be admitted to Western mines. She remarried in 1938 to prominent

geologist and Harvard professor Marland Pratt Billings. The couple had two children, and Fowler-Billings combined childrearing with her continued research trips, attendance at international conferences (in Russia and Copenhagen), and teaching appointments. She spent several years as an instructor in geology at Wellesley, Erskine Junior College, and Tufts College, and later worked for the state of New Hampshire and for the New England Museum of Natural History, but eventually spent most of her career engaged in private research.

Fowler-Billings was elected a fellow of the Geological Society of America, and she was a member of the Society of Women Geographers and an honorary member of the New Hampshire Geological Society. Her autobiography, *Stepping Stones: The Reminiscences of a Woman Geologist in the Twentieth Century*, was published in 1996, just before her death. She was actively writing up until her death at the age of 95, her last scientific article appearing in the March 1997 issue of *The Granite State Geologist*. She co-authored several publications with her husband, Marland Pratt Billings, with whom she traveled the world. In 1996, the Mount Washington Observatory established a Marland Pratt and Katharine Fowler-Billings Fund for Research in New England Geology to continue the legacy of their work.

Fox, Marye Anne (Payne)

b. 1947

Organic Chemist, Physical Chemist

Education: B.S., Notre Dame College, 1969; M.S., Cleveland State University, 1970; Ph.D., organic chemistry, Dartmouth College, 1974

Professional Experience: instructor, physical science, Cuyahoga Community College, 1970–1971; postdoctoral fellow and research associate, chemistry, University of Maryland, 1974–1976; assistant to associate professor, chemistry, University of Texas, Austin, 1976–1985, professor, chemistry, 1985–1991, director, Center for Fast Kinetics Research, 1986–1991, Waggoner Regents Chair in Chemistry, 1991–1998, Vice President for Research, 1994–1998; Chancellor and Professor of Chemistry, North Carolina State University, 1998–2004; Chancellor and Professor of Chemistry, University of California, San Diego, 2004–

Concurrent Positions: visiting scholar, Harvard University, 1989; Professeur Inviteé, Université Pierre et Marie Curie, Paris, 1992; visiting professor, Chemistry Research Promotion Center, National Science Council, Taipei, Taiwan, 1993; visiting scholar, University of Iowa, 1993; visiting professor, University of Chicago, 1997; Distinguished Visitor, Biomedical Research Council, Singapore, 2005

Marye Anne Fox is renowned for her research to solve major problems in organic photochemistry and electrochemistry, the branch of chemistry that deals with chemical changes produced by electricity and the production of electricity by chemical changes. She and her team members have pioneered the interdisciplinary field of organic photoelectrochemistry and mastered problems in physical, inorganic, and analytical chemistry. She was one of the first researchers to apply the research techniques of physical organic chemistry to reactions occurring on surfaces and to recognize semiconductor particles as ideal microenvironments for initiating controlled redox (or oxidation reduction) chemistry.

Fox says she had no qualms about deciding on science as a career while in high school because, at the time, almost everyone who was reasonably bright was interested in science. She chose chemistry because that field enabled her to steer clear of the messy aspects of biology as well as the extreme emphasis on math that is found in physics. She married a medical student after receiving her undergraduate degree, and since he was in Ohio, she entered the master's program at Cleveland State so she could complete her degree in one year even while supporting her husband. She accomplished this feat by teaching at the local community college. She was then able to pursue her own professional development successfully while she followed her husband around the country. When her husband received a residency in New Hampshire, she entered the doctoral program at Dartmouth. She was pregnant her second year at Dartmouth and had to decide whether to continue her studies or put a hold on a scientific career. Instead of leaving the program, she completed her doctorate in three years.

Fox has had a distinguished career as an administrator and teacher, as well as researcher. She has received numerous honors for teaching and mentoring graduate students. She has authored or co-authored more than 100 scientific articles and a textbook, *Organic Chemistry* (1994). She has been a member of the editorial advisory boards of numerous industry and academic journals, and was associate editor of the *Journal of the American Chemical Society* (1986–1995). She has been a consultant and advisor on numerous civic, corporate, corporate, and government projects and committees, including the National Science Board (1991–1996), executive committee of the National Academy of Sciences (1996–1999), National Research Council Governing Board (1997–1999), Women in Science and Technology Alliance National Board (1999–2002), and National Institute for the Environment (2001–2004).

Fox was elected to membership in the National Academy of Sciences in 1994. Her numerous awards and honors include the Garvan Medal (1988), the Arthur C. Cope Scholar Award (1989), and the Parsons Award for Public Service (2005), all of the American Chemical Society. She is a fellow of the American Association for the Advancement of Science, American Academy of Arts and Sciences,

Electrochemical Society, American Philosophical Society, and American Society for Photobiology.

Further Resources

University of California, San Diego. "Marye Anne Fox (Brief Biography)." <http://www.chancellor.ucsd.edu/biographybrief.html>.

Free, Helen (Murray)

b. 1923

Clinical Chemist

Education: B.A., College of Wooster, 1944; M.A., Laboratory Management and Health Care Administration, Central Michigan University, 1978

Professional Experience: control chemist, Miles Laboratories Corporation, 1944–1946, research chemist, Biochemical Section, 1946–1959, associate research biochemist and group leader, Ames Research Laboratories, 1959–1964, Ames Product Development Laboratory, 1964–1966, Ames Technical Service, 1966–1969, new product manager, clinical test systems, Ames Growth and Development, 1969–1974, senior new product manager, microbiological test systems, 1974–1976, director, special test systems, Ames Division, 1976–1978, director, clinical laboratory and reagents, Research Division, 1978–1982, consultant, Diagnostic Division, Bayer Healthcare (formerly Miles, Inc.), 1982–

Concurrent Positions: adjunct professor, biochemistry, Goshen College; adjunct professor, management, Indiana University, South Bend

Helen Free is a pioneer in the field of diagnostic chemistry who has been involved in the development of convenient test systems involving chemical reagents and the instrumentation to accompany those tests. Her research led to the development of the convenient tablet tests for urinalysis and to the introduction and development of easy dip-and-read tests for various urinary conditions, as well as tests for blood chemistry and histology. Clinical laboratory diagnostic methods and devices were comparatively primitive in the 1940s and 1950s, and her pioneer research at Miles Laboratories (later known as Bayer) contributed greatly to modern test procedures that are used in clinical laboratories throughout the world.

Free initially majored in Latin before changing to chemistry. She was employed at Miles Laboratory as a chemist right after college and remained with Miles (and its acquisition, Ames Laboratories) throughout her career, eventually obtaining a supplemental degree in management and administration, which helped her

advance through the company ranks. Free holds seven patents and is the author or co-author of more than 200 papers, many of them written with her husband, Alfred H. Free, who was also a chemist at Miles. The Frees co-authored the book *Urinalysis in Clinical Laboratory Practice* (1976), which is still considered the standard text on the subject. Helen Free also edited *Modern Urine Chemistry* (1986), which was published by Miles.

Free has received two honorary doctorates, and in 1980, she was awarded the Garvan Medal of the American Chemical Society as well as the Distinguished Alumni Award of the College of Wooster. She served as president of the American Association for Clinical Chemistry (AACC) in 1990 and president of the American Chemical Society in 1993. In that role, she urged members to participate in outreach to students and citizens to bring chemistry into their everyday lives. In 1995, she was the first recipient of the Helen M. Free Public Outreach Award. In 2006, the AACC presented her with the Award for Outstanding Contributions to Clinical Chemistry. She was inducted into the National Inventors Hall of Fame in 2000 for her work with her husband on “laboratory urinalysis and the more consumer-oriented ‘dip-and-read’ tests that first enabled diabetics to easily and accurately monitor their blood glucose levels on their own.”

Further Resources

Hall of Fame. “Helen Free.” http://www.invent.org/Hall_of_Fame/63.html.

Friend, Charlotte

1921–1987

Medical Microbiologist

Education: B.A., Hunter College, 1944; Ph.D., bacteriology, Yale University, 1950

Professional Experience: associate professor, microbiology, Sloan-Kettering Division, Medical College of Cornell University, 1952–1966; professor and director, Center for Experimental Cell Biology, Mt. Sinai School of Medicine, 1966–1987

Concurrent Positions: associate member, Sloan-Kettering Institute, 1949–1966

Charlotte Friend pioneered the idea that a virus causes cancer and a vaccine could be developed against it. Her major research focused on childhood leukemia, but she paved the way for a large number of other avenues of research into other types of cancer. She was the first to show that animals could be immunized with retrovirus preparations and protected against developing the disease. Her theory was initially scorned, and it was not until an internationally known scientist replicated

her work and assisted her in publishing the paper that researchers would even consider her ideas. Her experiments indicating that such protection is possible were later used by researchers trying to develop a vaccine against the human immunodeficiency virus (HIV).

Friend might have been motivated to work in the field of microbiology by the death of her father from bacterial endocarditis when she was three years old; when she was 10, she wrote a paper for a school assignment on why she wanted to be a bacteriologist. To help with family expenses, she worked in a physician's office during the day and took college classes at night. After college, she joined the Women Accepted for Voluntary Emergency Services (WAVES), the women's division of the U.S. Navy at the time, and worked in a naval hospital hematology lab. Upon her discharge, she used the GI Bill to obtain a doctorate from Yale and began researching the theory that leukemia was caused by a virus. She vaccinated mice by injecting them with a weakened form of the virus, now called "the Friend virus." She accepted appointments where she did not have to teach so that she could devote her time to research. In 1972, she announced the discovery of a method to alter a leukemia mouse cell in a test tube so that it would no longer multiply. Through chemical treatment, the malignant red blood cell could be made to produce hemoglobin, as do normal cells. Friend herself was diagnosed with lymphoma in 1981, but very few people knew of the diagnosis, as she did not want reviews of grants or manuscripts to be influenced by her illness. She continued to conduct research in the lab while undergoing therapy, but succumbed to the disease in 1987.

Friend received two honorary doctorates and many awards during her career, including the Alfred P. Sloan Award for Cancer Research and an award from the American Cancer Society in 1962. She was elected to the National Academy of Sciences in 1963. She received the Presidential Medal Centennial Award of Hunter College (1970), the Virus-Cancer Program Award of the National Institutes of Health (1974), and the Jacobi Medallion of Mt. Sinai Medical Center (1984). She was a member of the American Association for Cancer Research (president, 1976), New York Academy of Sciences (president, 1978), American Association of Immunologists, American Society of Hematology, and Tissue Culture Association.

Fromkin, Victoria Alexandria (Landish)

1923 2000

Linguist, Neurolinguist

Education: B.A., economics, University of California, Berkeley, 1944; M.A., University of California, Los Angeles, 1963, Ph.D., linguistics, 1965

Professional Experience: assistant professor, English, California State University, 1965; assistant professor, speech, University of California, Los Angeles (UCLA), 1966–1967, assistant professor, linguistics, 1967–1969, acting director, phonetics lab, 1968–1969, professor, linguistics, 1969–ca.1990, chair, department of linguistics, 1972–1976, dean of graduate division and vice chancellor of graduate affairs, 1979–1989

Concurrent Positions: linguistics delegate to China, National Academy Science, 1974; member, linguistics panel, National Science Foundation; visiting professor, University of Stockholm, 1977; member of executive board, Center for Applied Linguistics; visiting fellow, Wolfson College, Oxford University, 1983–1987; Ida Beam Professor, Departments of Neurology, Psychology, and Linguistics, University of Iowa, 1985; Cecil H. and Ida Green Visiting Professor, University of British Columbia, 1986; chair of Council of Graduate Deans, University of California, 1985–1986; McMaster University Centennial Lecturer and Learned Society Visitor, 1987

Victoria Fromkin was a linguist who conducted research in the brain mechanisms underlying language and cognition, including neurological problems, speech production, and perception studies. Linguistics is the science of language that encompasses phonetics, phonology, morphology, syntax, semantics, pragmatics, and the history of linguistics. After receiving her doctorate, she accepted a position at UCLA in the Linguistics Department. She advanced quickly through the ranks to professor of linguistics and performed a range of administrative responsibilities as department chair, dean of the graduate division, and vice chancellor for academic programs, the first woman vice chancellor at the university. In addition to her teaching and administrative duties, Fromkin was a prolific scholar and writer, serving as a member of the editorial boards of *Brain and Language*, *Studies in African Linguistics*, and the *Journal of Applied Psycholinguistics*. She investigated many aspects of the subject in her books, including the bestselling textbook *An Introduction to Language* (1974), which has been translated into six languages. Her other books included *Language, Speech, and Mind* (1988), *Speech Errors as Linguistic Evidence* (1974), and *Errors in Linguistic Performance: Slips of the Tongue, Ear, Pen, and Hand* (1980), and published papers on her research on dyslexia. For her research on how the brain processes language, but also partly for her own amusement, she kept a notebook recording the thousands of slips of the tongue and verbal mistakes she heard in everyday speech. In 1988, an edited collection was published dedicated to her work and influence entitled *Festschrift: Language, Speech and Mind: Studies in Honor of Victoria A. Fromkin*.

Even after her retirement in the early 1990s, Fromkin continued to serve on numerous distinguished committees and to stay involved with professional organizations. She was elected to membership in the National Academy of Sciences in

1996, and was a member of the linguistics panel of the National Science Foundation (1976–1978); linguistics delegate to the National Academy of Science of China (1974); member of the National Institutes of Health Sensory Disorder and Language Section (1982–1984); member of the National Research Council Committee on Basic Research Behavior and Social Sciences (1982–1988); and U.S. delegate and member of the executive board of the International Permanent Committee on Linguistics. She was a member or fellow of the Linguistics Society of America (president, 1985), the American Association of Phonetic Sciences, the Linguistics and the Language Sciences section of the American Association for the Advancement of Science (secretary, 1994–1997, and chair, 1997–1998), the Acoustical Society of America, the American Psychological Society, and the New York Academy of Sciences. She was the recipient of both a UCLA Distinguished Teaching Award and a UCLA Professional Achievement Award, and was active in mentoring female students and in promoting the role of women scientists, including being a member of the National Science Foundation Advisory Panel on Faculty Awards for Women in Science and Engineering (1990–1991).

Further Resources

University of California, Los Angeles. Faculty website. <http://www.linguistics.ucla.edu/people/fromkin/fromkin.htm>.

Fuchs, Elaine V.

b. 1950

Cell Biologist, Molecular Biologist, Biochemist, Geneticist

Education: B.S., chemistry, University of Illinois, 1972; Ph.D., biochemistry, Princeton University, 1977

Professional Experience: postdoctoral research fellow, biochemistry, Massachusetts Institute of Technology, 1977–1980; assistant professor, biochemistry, University of Chicago, 1980–1985, associate professor, molecular and cell biology and biochemistry, 1985–2002; professor, cell biology and development, Rockefeller University, New York, 2002–

Concurrent Positions: investigator, Howard Hughes Medical Institute, Maryland, 1988–

Elaine Fuchs is renowned for her research in molecular genetics and on the stem cells of skin and hair. She has researched the normal development of skin and hair, which originate from the same stem cell, as well as abnormalities that can lead to



Biologist Elaine Fuchs is presented with the National Medal of Science by President Barack Obama, 2009. (AP/Wide World Photos)

disorders and diseases of the skin, including skin cancer. She has focused on understanding the biochemical mechanisms that regulate genes during the growth and differentiation of the inner or basal epidermis cells. During differentiation, the basal cells stop multiplying, migrate to the skin's surface, and then undergo morphological and biochemical changes, the most pronounced being the production of keratin proteins. A malfunction of this process characterizes many skin diseases. In basal-cell carcinomas, for example, the cells do not differentiate or specialize at all, creating abnormal cell or tissue growth. Her research may also provide clues to other problems, such as abnormal or inhibited hair growth. She has published numerous research papers and has served on the editorial board of several journals, including the *Journal for Cell Biology*, *Genes and Development*, *Developmental Cell*, *Cell*, and *Stem Cell*. She currently holds positions as an investigator at the prestigious Howard Hughes Medical Institute, and professor and head of the laboratory of mammalian cell biology and development at Rockefeller University in

New York, overseeing numerous research projects related to skin and follicle development, wound-healing, and skin cancer, using both mouse and human cells.

Fuchs was elected to the Institute of Medicine in 1994 and the National Academy of Sciences in 1996. She is a fellow of the American Philosophical Society, New York Academy of Sciences, German Society of Dermatology, and the American Academy of Arts and Sciences. She was recognized early on in her career by being named a Presidential Scholar (1982); her numerous other awards and honors include the Searle Scholar Award (1981 and 1991), career development award of the National Institutes of Health (1982–1987), Bensely Award of the American Association of Anatomists (1988), Montagna Award of the Society of Investigative Dermatology (1995), Women in Cell Biology Senior Women's Career Achievement Award (1997), Richard Lounsbery Award of the National Academy of Sciences (2001), Cartwright Award from Columbia University (2002), Novartis Drew Award in Biomedical Research (2003), Dickson Prize in Medicine (2004), and Federation of American Societies for Experimental Biology Award for Scientific Excellence (2006).

Further Resources

Rockefeller University. Faculty website. <http://www.rockefeller.edu/research/abstract.php?id=42>.

Howard Hughes Medical Institute. "Elaine Fuchs, Ph.D." http://www.hhmi.org/research/investigators/fuchs_bio.html.

Furness, Caroline Ellen

1869–1936

Astronomer

Education: A.B., Vassar College, 1891; Ph.D., Columbia University, 1900

Professional Experience: high school instructor, 1891–1894; assistant, Vassar College Observatory, 1894–1903, instructor, 1903–1911, associate professor and acting director, 1911–1915, Maria Mitchell Professor of Astronomy, 1915–1936

Caroline Furness was one of the pioneer women astronomers who contributed to our knowledge of comets and minor planets. After matriculating at Vassar and teaching high school for several years, she was invited by professor Mary Whitney to return to Vassar as an assistant in the observatory. At the time, Whitney was carrying a heavy teaching load of eight different astronomy courses with a total of 160 students. With her own funds, she hired Furness as a teaching and research



Astronomers Caroline Furness of Vassar, left, and Annie Jump Cannon of Harvard Observatory, right, at a meeting of the American Astronomical Society in 1930. (Bettmann/Corbis)

College (1901–1912). She also published on the history of astronomy, including the relationship between religion and astronomy. Furness made several trips abroad, working at the astrophysical laboratory at the University of Groningen in 1908 and visiting scientific institutions throughout the world, including as a delegate to the Pan-Pacific Congress in Japan in 1926. She was also politically active, attending the International Woman Suffrage Alliance in Amsterdam in 1908 and petitioning the U.S. Congress to pass a suffrage amendment. Furness was elected a fellow of the Royal Astronomical Society in 1922 and was also a member of the American Association for the Advancement of Science, Association of Variable Star Observers, the British Astronomical Association, and the Astronomische Gesellschaft.

assistant between 1894 through 1910. Furness later succeeded her mentor and employer as professor of astronomy. Furness and Whitney also collaborated on the observation of comets and minor planets and, after 1909, on variable stars. After Whitney retired, Furness was acting director of the observatory and was named the Maria Mitchell Professor of Astronomy. During her tenure, the college trained a large number of women astronomers, and other observatories around the country looked to Vassar when they wanted to hire women.

Furness emphasized the use of photography in astronomical research, and her students were actively engaged in the research. She was particularly interested in cataloging the stars of the North Pole, and she edited *Observations of Variable Stars Made at Vassar*

G

Gaillard, Mary Katharine (Ralph)

b. 1939

Theoretical Physicist

Education: B.A., Hollins College, 1960; M.S., physics, Columbia University, 1961; D.Sci., theoretical physics, University of Paris-Sud, Orsay, 1968

Professional Experience: research assistant, Centre National de Recherche Scientifique (CNRS), Geneva, 1964–1968, research associate, 1968–1973, head of research, 1973–1979, director of research, 1980–1981; professor, physics, University of California, Berkeley, 1981–

Concurrent Positions: visiting scientist, European Center for Nuclear Research (CERN), Geneva, 1964–1981; Fermi National Accelerator Laboratory, Illinois, 1973–1974, 1983; Institute for Theory of Physics, University of California, Santa Barbara, 1985; principal investigator, National Science Foundation grant, 1982–; faculty senior scientist, Lawrence Berkeley Laboratory, 1981–

Mary Gaillard is known internationally for her research in theoretical physics, specifically on gauge theories, supergravity, physics of the early universe, supercollider physics, and effective theories of particle physics based on superstring theories. She has held distinguished appointments with the Centre National de Recherche Scientifique in Paris and at laboratories in the United States, such as Fermilab and Lawrence Berkeley Laboratory. Although she was born in New Jersey, and educated at two American universities, she received her doctorate in France and spent the early part of her career employed primarily in Europe. She found it difficult to secure a research position in France, but was briefly employed by her husband, also a physicist, to work in his lab until the couple moved to Geneva where she worked at the French National Center for Scientific Research. During this time, she also had an unpaid visiting position at the European Center for Nuclear Research and, discouraged by the lack of a regular position and the low salary at CNRS, in 1981, she accepted an offer as professor of physics at the University of California, Berkeley, the first woman faculty member in the department. In addition to her numerous scientific papers and publications, Gaillard has edited two books: *Weak Interactions* (1977) and *Gauge Theories in High*

Energy Physics (1983). Although she had a good science education and supportive family and teachers, she has said that, as a woman, she was still discouraged from pursuing theoretical physics because it was “too difficult.” She encourages young women to take more difficult mathematics courses in high school and college to prepare for scientific careers.

Gaillard was elected to membership in the National Academy of Sciences in 1991. She has received numerous awards and honors, including the Prix Thibaud of the Academy of Arts and Sciences of Lyons, the E. O. Lawrence Memorial Award of the U.S. Department of Energy, and the J. J. Sakurai Prize of the American Physical Society. She has held distinguished lectureships at institutions around the world and has served on important academic and governmental committees, such as the High-Energy Physics Advisory Panel, U.S. Department of Energy (1983 and 1991–1994); Astrophysics Advisory Committee (1985–1988) and Physics Advisory Committee (1986–1990), Fermilab; advisory committee, Theoretical Advanced Study Institute of Elementary Particle Physics (1983–1988); Subcommittee on Oversight Review, National Science Foundation Theoretical Physics Program (1988); and review committee, Argonne National Laboratory High Energy Physics Division (1988–1990). In 1996, President Clinton appointed her to a six-year term on the National Science Board. She has been active in professional associations and chaired the Committee on the Status of Women in Physics of the American Physical Society in 1985. She is a fellow of the American Academy of Arts and Sciences and the American Physical Society, and a member of the American Association for the Advancement of Science.

Further Resources

University of California, Berkeley. Faculty research website. <http://www.physics.berkeley.edu/research/faculty/gaillard.html>

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

Byers, Nina and Gary A. Williams. 2006. *Out of the Shadows: Contributions of Twentieth-Century Women to Physics*. New York: Cambridge University Press.

Gantt, Elisabeth

b. 1934

Botanist

Education: B.A., Blackburn College, 1958; M.Sc., Northwestern University, 1960, Ph.D., biology, 1963

Professional Experience: National Institutes of Health (NIH) research associate in microbiology, Dartmouth College Medical School, 1963–1966; NIH research associate in microbiology, Radiation Biology Laboratory, Smithsonian Institution, 1966–1988; professor, cell biology and molecular genetics, University of Maryland, 1988–

Elisabeth Gantt is noted for her work on plant physiology and biological structure, including the structures of photosynthetic apparatus, localization and characterization of phycobiliproteins, and membrane structure. For many years, her research has focused on examining the process of photosynthesis, which, especially in plants, is defined as the synthesis of complex organic materials, especially carbohydrates, from carbon dioxide, water, and inorganic salts using sunlight as the source of energy and with

the aid of chlorophyll and associated pigments. Her particular focus has been on photosynthesis and algae. Born in Yugoslavia, Gantt immigrated to the United States and received degrees from Blackburn College and Northwestern University. After receiving her doctorate from Northwestern University, she was an NIH research associate in microbiology, first at Dartmouth College Medical School and then at the Radiation Biology Laboratory of the Smithsonian Institution. She then joined the faculty of University of Maryland in botany and cell biology, where she is now Distinguished University Professor.

Gantt was elected to membership in the National Academy of Sciences in 1996. She has received numerous awards and honors, such as the Darbaker Prize of the Botany Society of America (1958) and the G. M. Smith Medal of the National Academy of Sciences (1994). She was a member of the board of fellows and associates of the National Research Council (1973–1976) and has been active in professional organizations, serving as president of the Phycological Society of America (1978) and the American Society of Plant Physiologists (1989). She is a



Botanist Elisabeth Gantt. (Courtesy of Scott Suchman, University Publications, University of Maryland)

fellow of the American Association for the Advancement of Science, and a member of the American Institute of Biological Sciences, American Society for Photobiology, and Japan Society of Plant Physiologists. She has been active in the American Society of Plant Biologists (ASPB), serving as secretary (1985–1987) and president (1988). In 2007, she was named an ASPB Fellow, an exclusive honor for long-term members of the profession.

Further Resources

University of Maryland. Faculty website. <http://www.life.umd.edu/CBMG/faculty/gantt/gantt2.html>.

Gardner, Julia Anna

1882 1960

Geologist

Education: A.B., Bryn Mawr College, 1905, A.M., 1907; Ph.D., geology, Johns Hopkins University, 1911

Professional Experience: public school teacher, 1906; assistant paleontologist, Johns Hopkins, 1911–1915; volunteer, Red Cross and American Friends Service Committee, France, 1917–1919; paleontologist, U.S. Geological Survey, 1920–1924, geologist, 1924–1952

Julia Gardner was an expert in the paleontology of the Coastal Plain, and her primary interest was in the mollusks found in sedimentary and other rocks. She was one of the few women geologists of the early twentieth century and one of the first women employed by the U.S. Geological Survey. She volunteered to serve in France with the Red Cross in World War I and was injured in the line of duty. She joined the U.S. Geological Survey after the war, and her research on the oil-bearing formations of the Coastal Plain, published in *Correlation of the Cenozoic Formations of the Atlantic and Gulf Coastal Plain and the Caribbean Region* (1943), was of particular importance to petroleum geologists. By the 1940s, her work in stratigraphic paleontology was of national and international importance, contributing especially to studies of economic geology in the Western hemisphere. During World War II, she provided strategic and tactical information through analyses of maps, serial photographs, and other sources for use by the armed forces. One of her contributions was that she was able to identify some of the Japanese beaches from which incendiary balloons were being launched by identifying the origin of the shells in the sand ballast of the balloons. After her official

retirement, she was rehired on a yearly contract basis for a project to prepare geological maps of the islands of the western Pacific.

Gardner received the Department of the Interior's Distinguished Service Award in 1952. That same year, she served as president of the Paleontological Society. She also was a member of the American Association of Petroleum Geologists and the Geological Society of America.

Garmire, Elsa (Meints)

b. 1939

Physicist, Electrical Engineer

Education: B.A., physics, Radcliffe College, 1961; Ph.D., physics, Massachusetts Institute of Technology, 1965

Professional Experience: research fellow, Massachusetts Institute of Technology, 1965–1966; research scientist, Electronics Research Center, National Aeronautics and Space Administration (NASA), 1965–1966; senior research fellow, electrical engineering and applied physics, California Institute of Technology, 1966–1973; senior research scientist, Center for Laser Studies, University of Southern California, 1974–1978, professor, electrical engineering and physics, and director, 1975–1995; dean and professor, Thayer School of Engineering, Dartmouth College, 1995–1997, professor, engineering sciences, 1997–

Concurrent Positions: president and founder, Laser Images, Inc., 1971–1973; visiting scientist, ITT Standard Telecom Labs, 1973–1974; visiting scientist, Thomson CSF, France, 1974; consultant, The Aerospace Corporation, 1975–1992; visiting professor, Sydney University, Australia, 1994–1995; visiting professor, Telebras and University of Sao Paulo, Brazil, 1992; visiting professor, electrical engineering and computer science, University of California, Berkeley, 2000–2001; Jefferson Science Fellow, U.S. Department of State, 2007–2008

Elsa Garmire has had a distinguished career in laser research since receiving her doctorate in nonlinear optics under Charles H. Townes, who received the Nobel Prize in Physics. The term “laser” is an acronym for *light amplification by stimulated emission of radiation*; the term was coined about 1960. Her research is focused on lasers, integrated optics, nonlinear optics, spectroscopy, and quantum electronics. Throughout her career, she has been on the front lines of research and innovations in the field of laser and optical studies. She holds 10 patents and has been a delegate to several international symposiums on lasers and optics.

Garmire has published more than 200 papers in scientific journals and has been associate editor of both *Optics Letters* and *Fiber and Integrated Optics*.

Garmire was appointed a senior research scientist at the Center for Laser Studies at the University of Southern California in 1974 and was soon promoted to professor of electrical engineering and physics, associate director of the Center for Laser Studies, and then director of the center. She was the first woman to be appointed to the engineering faculty at the University of Southern California and, in 1995, she became the dean of the Thayer School of Engineering at Dartmouth College, the first woman dean of engineering in an Ivy League school. Garmire's expertise and reputation are reflected in the number of visiting scholarships and consultancies she has held outside of academia and around the world.

Garmire was elected to membership in the National Academy of Engineering in 1989 and to the American Academy of Arts and Sciences in 1996. She is a fellow of the Institute of Electrical and Electronics Engineers, the American Physical Society, the Optical Society of America (director-at-large, 1983–1986; president, 1995), and the Society of Women Engineers, which honored her with an Achievement Award in 1994. Her service to professional and scientific boards has been extensive and includes membership on the Air Force Scientific Advisory Board (1985–1989) and the Presidential Medal of Science Selection Committee (1996–1998), as well as chairing the National Academy Committee to Assess Technological Literacy (2002–2006); most recently, she has been named a Councilor to the National Academy of Engineering (2002–2008).

Further Resources

Dartmouth College. Faculty website. <http://engineering.dartmouth.edu/faculty/regular/elsagarmire.html>.

Gast, Alice P.

b. 1958

Chemical Engineer

Education: B.S., chemical engineering, University of Southern California, 1980; M.A., chemical engineering, Princeton University, 1981, Ph.D., chemical engineering, 1984

Professional Experience: assistant professor, chemical engineering, Stanford University, 1985–1990, associate professor, chemical engineering and chemistry (by courtesy), 1991–1995, professor, chemical engineering and chemistry

(by courtesy), 1995–2001; vice president, research, and associate provost, Massachusetts Institute of Technology (MIT), 2001–2006, and Robert T. Haslam Professor of Chemical Engineering, 2001–2006; president, Lehigh University, Pennsylvania, 2006–

Alice P. Gast is a chemical engineer who is currently the president of Lehigh University in Bethlehem, Pennsylvania, the first female president in that institution's history. She previously taught chemical engineering and chemistry at Stanford University and at MIT, where her research interests included the physics of complex fluids, colloidal suspensions, and micelles and emulsions, and she has been acknowledged for her commitment to engineering education. Gast received her doctorate in chemical engineering from Princeton University

in 1984 and spent a year as a postdoctoral fellow at the École Supérieure de Physique et de Chimie Industrielles in Paris, where she returned as a visiting professor years later. She has been an invited lecturer at numerous universities and was an affiliated faculty at the Stanford Synchrotron Radiation Laboratory (1994–2002). She has sat on committees and advisory boards for the National Research Council Committee for Science, Technology, and the Law; the National Research Council Committee on Science, Engineering, and Public Policy; the National Council for Science and the Environment; the Homeland Security Science and Technology Advisory Committee; and the National Space Biomedical Research Institute.

Gast was elected to the National Academy of Engineering in 2001 and is a fellow of the American Academy of Arts and Sciences, American Association for the Advancement of Science, International Council for Science, and Canadian Institute for Advanced Research. She is also a member of the American Chemical Society, American Institute of Chemical Engineers, American Physical Society, International Polymer Colloids Group, and Materials Research Society. Among her awards and honors are the National Academy of Science Award for Initiative



Chemical engineer and President of Lehigh University, Alice P. Gast, 2008. (Courtesy of Lehigh University)

in Research (1992), Allan P. Colburn Award of the American Institute of Chemical Engineers (1992), Alexander von Humboldt Award (1998), and American Chemical Society Award in Colloid and Surface Chemistry (2006). She is married to Bradley J. Askins, a computer scientist who also teaches at Lehigh.

Further Resources

Lehigh University. "Office of the President: Alice P. Gast." <http://www3.lehigh.edu/president/default.asp>.

Gayle, Helene Doris

b. 1955

Pediatrician, Epidemiologist

Education: B.A., psychology, Barnard College, 1976; M.D., University of Pennsylvania, 1981; M.S., public health, Johns Hopkins University, 1981

Professional Experience: resident, Children's Hospital Medical Center, Washington, D.C., 1981–1984; resident, Epidemic Intelligence program, Centers for Disease Control and Prevention (CDC), 1984–1986, medical epidemiologist and coordinator, Division of HIV/AIDS, 1984–1995; medical researcher, AIDS Division, U.S. Agency for International Development, 1992–1995; director, National Center for HIV, STD, and TB Prevention, CDC, 1995–2001; director, HIV, TB, and Reproductive Health Program, Bill and Melinda Gates Foundation, 2001–2006; Assistant Surgeon General and Rear Admiral, U.S. Public Health Service, 2001–; president and CEO, CARE USA, 2006–

Helene Gayle is a renowned epidemiologist of infectious diseases such as acquired immune deficiency syndrome (AIDS), human immunodeficiency virus (HIV), and tuberculosis. She has worked with international organizations on issues of disease prevention and control. Gayle majored in psychology as an undergraduate before attending medical school, and after hearing a noted researcher speak about small-pox eradication, she became interested in public health. She began her career in the 1980s, when AIDS was reaching epidemic proportions. At the CDC, she concentrated on the effect of AIDS on children, adolescents, and their families, both in the United States and worldwide, and she found that the African American community, especially black women, were at especially high risk for contracting HIV. Without an available vaccine, she focused her attention on educating the populations of both the United States and Africa on ways to prevent HIV infection, the virus that causes AIDS. By the late 1990s, HIV/AIDS had gained more public



American pediatrician, epidemiologist, and President of the International AIDS Society, Helene Gayle speaks in Rio de Janeiro, Brazil, 2005. (AP/Wide World Photos)

attention and research funding, but Gayle was among those who warned against a premature sense that the threat of the virus had been lessened.

Gayle has received numerous awards, such as the U.S. Public Health Service achievement medal. She has been a guest lecturer to numerous universities and organizations and a consultant to international health organizations such as WHO, UNICEF, the World Bank, and UNAID. She was the editor of *Global Mobilization for HIV Prevention: A Blueprint for Action* (2002).

Further Resources

CARE USA. "Helene D. Gayle: President and CEO." <http://www.care.org/about/biogayle.asp>.

Geiringer (Von Mises), Hilda

1893 1973
Mathematician

Education: Ph.D., mathematics, University of Vienna, 1917

Professional Experience: editorial assistant, *Fortschritte der Mathematik* (Advances in Mathematics), 1919–1920; assistant, Institute of Applied Mathematics, University of Berlin, 1921–1927, lecturer, 1927–1933, professor emeritus, 1956–1973; research associate, Institute of Mechanics, University of Brussels, 1933–1934; professor, mathematics, University of Istanbul, 1934–1939; lecturer, Bryn Mawr College, 1939–1944; professor and chair, mathematics department, Wheaton College, Massachusetts, 1944–1959; research fellow, mathematics, Harvard University, 1955–1959

Concurrent Positions: instructor, mechanics/engineering science, Brown University, Rhode Island, 1942; research fellow, mathematics, Harvard University, 1954–1973

Hilda Geiringer was a mathematician who worked on statistics and probability theory, and developed the fundamental Geiringer equations for plane plastic distortions. Her parents helped support her financially while she studied mathematics for a Ph.D. at the University of Vienna. At the Institute of Applied Mathematics at Berlin, she worked as an assistant to renowned mathematician Richard Von Mises, who would later become her second husband. After receiving her doctorate from the University of Vienna in 1917, she was on the staff of a review journal for three years. It was unusual for a woman mathematician to find a teaching position in the 1920s in Germany, but she was appointed an assistant at the University of Berlin in 1921 and a member of the staff starting in 1927. Once Hitler came to power, however, Jews were prohibited from employment in universities (among other positions), and she was forced to flee Germany in 1933 with her child along with other Jewish professionals. She went to Brussels, where she found a position at the Institute of Mechanics, and then followed Von Mises on to the University of Istanbul. Much of her early work was published while in Turkey, where she became interested in mathematical applications for the new theories of genetics. In this work, she was an unacknowledged pioneer and precursor to the fields of genetic mapping, bioinformatics, and genetic engineering.

In 1939, she came to the United States with an appointment as a lecturer at Bryn Mawr College. In 1943, she married Richard Von Mises, who now had a faculty position at Harvard. Geiringer relocated to Massachusetts to be near Von Mises and to take a permanent position as professor and chair of the mathematics department at Wheaton College. The position at Wheaton included heavy teaching and administrative duties, and Geiringer continued to apply for a research position at other universities. Having escaped from Germany because of persecution against Jews, she now faced discrimination against women at the higher research institutions. To a professor at Princeton University, she wrote, “I hope there will be better

conditions for the next generations of women. . . . In the meantime, one has to go on as well as possible.” After Von Mises’s death in 1953, she continued to teach at Wheaton until retiring in 1959, but also spent several years as a research fellow at Harvard, editing Von Mises’s work for publication and conducting her own research. She published new editions of his books, including her supplementary addition of new material, including *Probability, Statistics, and Truth* (1957) and *Mathematical Theory of Probability and Statistics* (1964).

Geiringer became a renowned mathematician with an international reputation. She became a friend and correspondent with Albert Einstein. She was named professor emerita by University of Berlin in 1956, more than 20 years after she fled Germany. She received an honorary degree from Wheaton in 1960, and in 1967, the University of Vienna made a special presentation on the occasion of the fiftieth anniversary of her graduation. She was elected a fellow of the American Academy of Arts and Sciences. Twice-married, she used the name Geiringer professionally, although in some sources she is identified as Hilda Von Mises or under her first married name, Hilda Pollaczek.

Further Resources

Agnes Scott College. “Hilda Geiringer von Mises.” Biographies of Women Mathematicians. <http://www.agnesscott.edu/lriddle/women/mises.htm>.

Geller, Margaret Joan

b. 1947

Astrophysicist, Cosmologist, Astronomer

Education: B.A., University of California, Berkeley, 1970; M.A., Princeton University, 1972, Ph.D., Physics, 1975

Professional Experience: National Science Foundation predoctoral fellow, Princeton University, 1970–1973; postdoctoral fellow, Center for Astrophysics, 1974–1976; research fellow, Harvard College Observatory, 1976–1978, research associate, 1978–1980; lecturer, Harvard University, 1977–1980, assistant professor, 1980–1983; astronomer, Harvard-Smithsonian Astrophysical Observatory, 1983–1991, senior astronomer, 1991–

Concurrent Positions: senior visiting fellow, Institute of Astronomy, Cambridge University, 1978–1980



Astrophysicist, astronomer, and cosmologist Margaret Joan Geller, 1993. (Roger Ressmeyer/Corbis)

Margaret Geller is one of the foremost cosmologists of the twentieth century. Cosmology is the branch of astronomy that deals with the general structure and evolution of the universe; since the 1980s, she has worked on surveys of the distribution of galaxies in the universe. She and her team constructed three-dimensional maps that revealed, for the first time, that galaxies such as the Earth's own Milky Way are arranged in very large patterns resembling soapsuds. In the nearby universe, thin walls marked by thousands of galaxies surround vast dark regions in which there are very few galaxies. In 1989, Geller and her collaborator, John Huchra of Harvard, discovered "the Great Wall," a huge arc of galaxies spanning the area the scientists sur-

veyed. The wall is a chain of galaxies on the order of 500 million by 200 million by 15 million light-years in extent; this is the largest coherent structure yet seen in the universe.

Geller was inspired by the sciences when, as a child, she accompanied her father, a graduate student in crystallography, to his x-ray lab. She received a National Science Foundation fellowship while pursuing her master's, and went on to become only the second woman to earn a doctorate in physics from Princeton. While visiting the Institute of Astronomy at Cambridge University, she decided to examine the large-scale structure of the universe, of which little was known. She joined forces with Huchra, who specialized in using telescopes to gather the necessary data for these explorations, to complement her theoretical, analytical view. She was only the second woman astronomer to receive tenure at Harvard; the first was **Cecilia Payne-Gaposchkin**. In addition to Geller's scientific publications, she has prepared two films for the general public. The video *Where the Galaxies Are* (1991), which premiered at the National Air and Space Museum, is a general description of her work; the film *So Many Galaxies . . . So Little Time* (1992) provides insights into the lives and work of scientists and their students. She was also interviewed for the television program "Mysteries of Deep Space" in the *NOVA* series on public television in 1997.

Geller was elected to the National Academy of Sciences in 1992. In 1990, she received a prestigious five-year MacArthur “genius grant.” Other awards included the Newcomb-Cleveland Prize of the American Academy of Arts and Sciences (1990) and the Helen Sawyer Hogg Prize of the Royal Astronomical Society of Canada (1993), named for the woman who cataloged variable stars in globular clusters. In 1997, Gellar won a Library Lion award from the New York Public Library, and in 2002, she received the ADION Medal from Nice Observatory in France. She has published widely in scientific journals and has been on the editorial review board for *Science* since 1991. She is a fellow of the American Physical Society, American Association for the Advancement of Science, International Astronomical Union, and American Astronomical Society.

Further Resources

Harvard University. Faculty website. <http://cfa-www.harvard.edu/~mjg/>.

Gerry, Eloise B.

1885–1970

Botanist

Education: A.B., Radcliffe College, 1908, A.M., 1909; M.S., Smith College, 1909–1910; Ph.D., plant physiology, University of Wisconsin, 1921

Professional Experience: expert, Forest Products Laboratory, U.S. Forest Service, 1910–1911, microscopist, 1911–1928, senior microscopist, 1928–1947, technologist, Forest Products, 1947–1955

Concurrent Positions: lecturer, forest products, University of Wisconsin, 1911–1955

Eloise Gerry was an international expert on the properties of forest woods. She was the first woman appointed to the professional staff of the U.S. Forest Service at Madison, Wisconsin and one of the first women to specialize in forest products research. After receiving her master’s degree from Smith College, she joined the staff of the newly opened Forest Products Laboratory, where she spent her entire career. She joined the department as a wood microscopist and was ultimately promoted to forest products technologist. She had developed a highly specialized method for cutting wood specimens and preparing photomicrographs, but when she arrived at the new laboratory, the equipment she needed was not yet available. The botany department at the University of Wisconsin temporarily provided space

and the equipment for her work. Her first project for the U.S. Forest Service was to collect wood samples from throughout the United States. After the samples were collected and analyzed, she moved to other research projects. Her first paper was published in 1914 on tyloses, the plugging of wood cells that restricts the movement of liquid. In 1916, over the objections of lab administrators, she took her microtome and microscope to Mississippi and Florida to gather and analyze core samples from living trees for a project on naval stores. As a result of this research, she became a national expert in naval stores and wrote a book, *Naval Stores Handbook* (1935).

During World War II, Gerry worked on projects of selecting wood suitable for packing supplies to ship to the armed services in a variety of climates all over the world. After the war, her research involved foreign woods, on which she prepared 56 reports in the Foreign Wood Series of the Forest Products Laboratory. She published more than 120 papers in technical and trade journals, in FPL publications as well as those of the Forest Service and the U.S. Department of Agriculture. She was elected a fellow of the American Association for the Advancement of Science, and was a member of the American Chemical Society, the American Forestry Association, the Society of American Foresters, the Forest History Society, and the International Association of Wood Anatomists.

Giblett, Eloise Rosalie

1921–2009

Hematologist, Geneticist

Education: student, Mills College, 1939–1940; B.S., University of Washington, 1942, M.S., microbiology, 1947, M.D., 1951

Professional Experience: intern and resident, University of Washington, 1951–1952, postdoctoral fellow, 1953–1955, clinical associate, School of Medicine, 1955–1957, clinical instructor to associate professor, 1957–1967, research professor, medicine, 1967–1987; associate director, Puget Sound Blood Center, 1967–1979, executive director, 1979–1987, emerita

Concurrent Positions: postdoctoral fellow, Medical School, University of London, 1953–1955

Eloise Giblett discovered that an inadequate supply of two specific enzymes causes inherited deficiencies in the body's immune system and led the research on gene therapy to treat these deficiencies. She also discovered a wide range of new genetic

markers, including blood groups and serum proteins, and did important research in blood group antibodies. Giblett published more than 200 papers and textbook chapters on various aspects of inherited characteristics, particularly those in human blood. These include iron kinetics, red-cell destruction owing to isoantibodies, detection of variants in blood group antigen, serum protein, red-cell enzyme genetic systems, and changes in red-cell antigens associated with marrow stress. She is the author of the book *Genetic Markers in Human Blood* (1969).

After college, Giblett joined the Women Accepted for Voluntary Emergency Services (WAVES), the women's branch of the U.S. Navy at the time, as a medical technician. She then used funds from the GI Bill to attend medical school, receiving a master's in microbiology and then an M.D. degree, specializing in hematology and human genetics. She has participated on many significant committees and commissions as a member of the National Institutes of Health Genetics Study Section; the National Heart, Lung, and Blood Research Review Committee; the National Blood Resources Committee; and the Food and Drug Administration Toxicology Advisory Committee. In the 1960s, she was associate editor of the journals *Transfusion* and *American Journal of Human Genetics*. In addition to teaching at the University of Washington, she served for 20 years as the director of the Puget Sound Blood Center. In 2004, she was the keynote speaker at the Center's sixtieth-anniversary celebration.

Giblett was elected to the National Academy of Sciences in 1980 and received the Emily Cooley Award (1975), the Karl Landsteiner Award (1976), and the Philip Levine Award (1978). She was a member of the American Society of Hematology, American Society of Human Genetics (president, 1973), American Association of Immunologists, and Association of American Physicians.

Gibson, Eleanor Jack

1910 2002

Psychologist

Education: A.B., Smith College, 1931, A.M., 1933; Ph.D., psychology, Yale University, 1938

Professional Experience: assistant, psychology, Smith College, 1931–1933, instructor, 1933–1940, assistant professor, 1940–1949; research associate, Cornell University, 1949–1966, professor, psychology, 1966–1980

Concurrent Positions: visiting professor, Massachusetts Institute of Technology, 1973; University of California, Davis, 1978; University of Pennsylvania, 1984;

University of South Carolina, 1987; University of Connecticut, 1988; Emory University, 1988–1990; Center for Advanced Behavioral Studies, University of Minnesota; Salk Institute

Eleanor Gibson was recognized as an expert in the psychology of learning and was most well-known for her studies of perception in young children. In the late 1950s, she designed a “visual cliff” experiment to study depth perception in infants and toddlers. The experiment involved placing the child on a wooden table with a large plate of glass attached, and encouraging them to crawl off the “edge” of the table onto the glass, which most of the children would not do. Gibson repeated her experiment with kittens and other animals, and concluded that our sense of depth prevents falls and injuries. In 1961, she co-authored (with her colleague Richard D. Walk) the book *A Comparative and Analytical Study of Visual Depth Perception*. Their work received media attention (it was reported in *Life* magazine) and was reprinted in psychology textbooks.

Gibson began her teaching career at Smith College where, after receiving her Ph.D. from Yale, she was promoted to assistant professor. While still a graduate student, she married another psychologist, James Gibson, with whom she often collaborated. But she faced discrimination as a woman and as a married woman when it came to her career. At Yale, she was denied use of the laboratories and libraries as well as admission to some seminars, and some of her work was published under a lab director’s name. When James Gibson moved to Cornell, Eleanor was unable to secure a faculty position there and worked as his research associate until 1966, when the rules about hiring married couples changed and she was appointed professor of psychology. Before and even after her retirement, she held numerous research positions and visiting professorships at other institutions. In 1982, she was invited to China to mentor psychologists there on her methods and research.

Gibson was the author or co-author of five books, including her memoir, *Perceiving the Affordances: A Portrait of Two Psychologists*, published in 2001. She was elected to the National Academy of Sciences in 1971. She was a member of the Society of Experimental Psychologists and the American Psychological Association (APA), receiving an APA award in 1968 and a G. Stanley Hall Award in 1970.

Gilbreth, Lillian E. Moller

1878 1972

Industrial Psychologist, Engineer

Education: B. Litt, University of California, Berkeley, 1900, M.A., 1902; Ph.D., psychology, Brown University, 1915

Professional Experience: co-owner, Gilbreth, Inc., 1904–1924; consultant, Gilbreth Research Associates, 1924–1972

Concurrent Positions: visiting lecturer, Purdue University, 1924–1935, professor of management, 1935–1948; chair, department of personnel relations, Newark College of Engineering, 1941–1943; professor of management, University of Wisconsin, 1955

Lillian Gilbreth was one of the founders of the discipline of modern scientific management and efficiency and a pioneer in the field of industrial psychology. Her 1914 book, *The Psychology of Management*, was a groundbreaking work on the health of industrial workers and had an enormous impact on the development of business practices in the twentieth century. Soon after graduating from college, she married Frank Gilbreth, a builder with an interest in inventing equipment and techniques for improving efficiency. Her concern for the human needs of workers complemented his interests in industrial efficiency, and they both altered their career paths in order to work together at their own consulting firm. She had intended to study literature but focused her doctoral studies on psychology instead, earning her Ph.D. in 1915 after already publishing her first book, and in the midst of working with her husband and bearing 12 children in 17 years. The large Gilbreth family were themselves an experiment in organization and efficiency, using their home as a model for their studies. They trained management professionals in addition to lecturing in schools of engineering and business, consulting for industrial firms, and writing for both professional and popular magazines. The Gilbreths were the forerunners of the science of time and motion analysis, and Lillian Gilbreth's contribution to the field was an appreciation of the human element in applying time and motion studies.

After Frank Gilbreth died in 1924, Lillian still had children to raise, and started a new consulting firm, Gilbreth Research Associates. She counted numerous retailers among her clients, including Johnson & Johnson, Macy's, and Sears & Roebuck. She was hired as a guest lecturer at Purdue University, a position that Frank Gilbreth had held, and later received a regular faculty appointment as the first female professor of engineering at Purdue. She began an intensive study of applying modern business methods in the home. Together, the Gilbreths had co-authored *Fatigue Study: The Elimination of Humanity's Greatest Unnecessary Waste* (1916) and *Applied Motion Study* (1917). Her two other major publications included *The Home-Maker and Her Job* (1927) and *Management in the Home* (1954), as well as numerous articles in such popular magazines as *Good House-keeping* and *Better Homes and Gardens*. She did significant research on people with disabilities 50 years before the American Disabilities Act, developing a

model kitchen for the handicapped at the Institute of Rehabilitation Medicine at New York University Medical Center and discussing special equipment and routines for housework in *Normal Lives for the Disabled* (1944). Among her innovations was the idea for opening trashcans by stepping on a handle, an invention now widely used in the home.

Gilbreth has the honor of being the first woman elected to National Academy of Engineering (1965). In 1921, she was named an honorary member of the Society of Industrial Engineers, which did not admit women to membership. In 1966, she received the Hoover Medal of the American Society of Civil Engineers, and in 1987, Purdue established a distinguished professorship of engineering in her name. The Society of Women Engineers has also established a fellowship in her memory. The humorous reminiscences of the Gilbreth family were recorded by Frank Gilbreth, Jr., and Ernestine G. Carey in *Cheaper by the Dozen* (1948; later a motion picture) and *Belles on Their Toes* (1950).

Further Resources

Wood, Michael C. and John C. Wood, eds. 2003. *Frank and Lillian Gilbreth: Critical Evaluations in Business and Management*. New York: Routledge.

Lancaster, Jane. 2004. *Making Time: Lillian Moller Gilbreth A Life Beyond "Cheaper By the Dozen."* Boston, MA: Northeastern University Press.

Gill, Jocelyn Ruth

1916–1984

Astronomer

Education: A.B., Wellesley College, 1938; S.M., astronomy and astrophysics, University of Chicago, 1941; Ph.D., astronomy, Yale University, 1959

Professional Experience: laboratory assistant and instructor, astronomy, Mount Holyoke College, 1940–1942; staff member, radiation laboratory, Massachusetts Institute of Technology (MIT), 1942–1945; instructor to assistant professor, astronomy, Smith College, 1945–1952; instructor, University of California extension, 1946–1948; assistant professor, Mount Holyoke, 1952–1957; associate professor, mathematics and astronomy, Arizona State College, 1959–1960; research assistant, astronomy, Yale University, 1960–1961; staff scientist, astronomy and astrophysics, Office of Space Science and Applications, National Aeronautics and Space Administration (NASA), 1961–1963, chief of in-flight science, Manned

Space Science Program Office, 1963–1966, staff scientist, Manned Flight Experiment Office, 1966–1968, program scientist, 1968–1984

Jocelyn Gill conducted research involving motion of Neptune's satellite (Triton), celestial mechanics, and numerical analysis of satellite orbits. She held prominent positions in NASA's manned space flight program. After receiving her master's degree, Gill was employed as a laboratory assistant and instructor of astronomy at Mount Holyoke. The beginning of World War II opened up many new industries and research positions for women. The radiation laboratory at MIT hired many women to continue the work that men formerly had performed. After working at MIT, Gill taught astronomy at several schools while continuing work on her doctorate at Yale. She had several other assignments until she received an appointment with NASA in 1961 with the Office of Space Science and Applications in the Washington, D.C., area. After the former Soviet Union launched *Sputnik*, there was a crash program to catch up to and surpass the Russian space program. Again the U.S. program opened up many positions for women scientists with expertise in astronomy and astrophysics, as there simply were not enough men trained in these fields. She was chief of in-flight science from 1963 to 1966 and participated in a solar eclipse flight in 1963. She also worked on the Gemini Science program.

Gill received the Federal Women's Award in 1966 representing NASA. She was elected a fellow of the American Association for the Advancement of Science and was also a member of the American Astronomical Society and the American Association of Variable Star Observers.

Gleitman, Lila R.

b. 1929

Psychologist

Education: B.A., literature, Antioch College, 1952; M.A., linguistics, University of Pennsylvania, 1962, Ph.D., 1967

Professional Experience: senior scientist, Eastern Pennsylvania Psychiatric Institute, Philadelphia, 1965–1968; assistant professor, linguistics, Swarthmore College, 1968–1971; William T. Carter Professor of Education, University of Pennsylvania, 1972–1979, professor, psychology, 1981–2001 (Steven and Marcia Roth Professor of Psychology, 1989–1994), and professor, linguistics, 1992–2001, emerita

Concurrent Positions: Alfred P. Sloan Cognitive Science Fellow, linguistics and philosophy, Massachusetts Institute of Technology, 1978; Alfred P. Sloan

Cognitive Science Fellow, School of Social Science, University of California, Irvine, 1979; Vera T. Brittain Fellow, Somerville College, Oxford University, England, 1985; co-founder and co-director, Institute for Cognitive Science, University of Pennsylvania, 1991–2001; visiting faculty, Cognitive Science Institute (RUCCS) Rutgers University, 2000–; visiting scientist, SISSA, Trieste, 2001–2008

Lila Gleitman is a world-renowned psychologist who specializes in psycholinguistics and language acquisition, including representation of the sound wave, syntax, and construction of the lexicon. She has pioneered the field of linguistics theory in cognitive science, specifically focusing on developmental linguistics and children's language acquisition. She received her doctorate from the University of Pennsylvania and taught at Swarthmore College before returning to University of Pennsylvania to teach in the departments of education, psychology, and linguistics. She taught at Pennsylvania for 30 years, as did her husband, fellow psychologist Henry Gleitman. The two often collaborated and Gleitman's work has been supported by research grants from the National Science Foundation and National Institutes of Health. She has been an invited lecturer at numerous universities in the United States and abroad. She has authored dozens of articles and book chapters, and edited or co-edited several textbooks, including *Language and Experience: Evidence from the Blind Child* (1985) and *Invitation to Cognitive Science, Volume I: Language* (1996). Two volumes of essays by colleagues have been published in her and her husband's honor.

Gleitman was elected to the National Academy of Sciences (NAS) in 2000 and, since her retirement, has served on NAS advisory committees. She received honorary doctorates from the University of Chicago (2005) and the University of Pennsylvania (2008). Among her more recent awards and honors are a Women in Science Award from the New York Academy of Sciences (2002), a Distinguished Scientific Contribution Award of the American Psychological Association (2003), and the John McGovern Award in the Behavioral Sciences from the American Association for the Advancement of Science (AAAS) (2003). She is a fellow or member of the AAAS, Society of Experimental Psychologists, American Academy of Arts and Sciences, Cognitive Science Society, Linguistic Society of America (president, 1993), Society for Philosophy and Psychology (president, 2006–2007), and Language Development Society (president, 2006–).

Further Resources

University of Pennsylvania. Faculty website. <http://www.psych.upenn.edu/people/gleitman>.

Glusker, Jenny (Pickworth)

b. 1931

Crystallographer, Cancer Researcher

Education: B.A., Somerville College, Oxford University, 1953, M.A. and D. Phil., chemistry, 1957

Professional Experience: research fellow, x-ray crystallography, California Institute of Technology, 1955–1956; research associate, Institute for Cancer Research (later Fox Chase Cancer Center), Philadelphia, 1956–1966, director, 1967–1979, senior member, 1979–2003

Concurrent Positions: research associate professor, University of Pennsylvania, 1969–1979, adjunct professor, biochemistry and biophysics, 1980–

Jenny Glusker is renowned for her work in x-ray crystallography and is a leading authority on chemical carcinogenesis based on the structure determinations of various carcinogens. She has performed calculations on simple aromatic hydrocarbons that act as models for polycyclic aromatic hydrocarbons, and she has studied many antitumor agents that inhibit chemical carcinogenesis. X-ray crystallographic data are powerful tools, for they provide a three-dimensional structure, the absolute configuration, and the preferred conformations of a sample. While a student at Somerville College, she worked with Dorothy Hodgkin, contributing to research on the structure of vitamin B₁₂. Hodgkin went on to receive the Nobel Prize in Chemistry in 1964.

Both of Glusker's parents were physicians, and her mother was a member of the first class of women students in the medical school at Glasgow University during World War I. She encouraged both of her daughters to combine marriage with a career. Jenny Pickworth met her future husband while studying in England, and the two went to the United States in 1955. When they married, each had a postdoctoral appointment at the California Institute of Technology, where Jenny was a member of Linus Pauling's research team. The couple then faced the problem of finding jobs at the same location. They succeeded in finding positions in Philadelphia, where she joined the Institute for Cancer Research, later named the Fox Chase Cancer Center. When she joined the center, the director not only encouraged married women to work, but allowed Glusker to work part-time while her children were young. When her youngest child was just two years old, the director of the institute died, and Glusker was offered and accepted the position. She retired from the laboratory in 2003.

Glusker has published more than 100 scientific articles, edited numerous books, and published two books: *Crystal Structure Analysis: A Primer* (1972; 2nd ed.,

1985) and *Crystal Structure Analysis for Chemists and Biologists* (1994). She is the editor of *Acta Crystallographica* and serves on the editorial boards of several other journals. She has been very active in promoting the careers of many young researchers either through her teaching at the university or supervision of graduate students at the institute. Among the awards she has received are the Garvan Medal of the American Chemical Society (1979) and the Fankuchen Award of the American Crystallographic Association (1995). She is a member of the American Association for the Advancement of Science, American Crystallographic Association (president, 1979), American Chemical Society, American Society of Biological Chemists, and Biophysical Society.

Further Resources

Fox Chase Cancer Center. Biography. <http://dunbrack.fccc.edu/GluskerSymposium/Bio.php>.

Fox Chase Cancer Center. Staff website. <http://www.fccc.edu/research/pid/glusker/>.

Goeppert-Mayer, Maria

1906–1972

Physicist

Education: Ph.D., physics, University of Göttingen, 1930

Professional Experience: research assistant, physics, Johns Hopkins University, 1931–1939; lecturer, Columbia University, 1939–1946; senior physicist, Argonne National Laboratory, 1946–1960; professor, School of Science and Engineering, University of California, San Diego, 1960–1972

Concurrent Positions: lecturer, Sarah Lawrence College, 1941–1942, 1945; volunteer professor, Fermi Institute of Nuclear Studies, University of Chicago, 1946–1959

Maria Goeppert-Mayer was a nuclear physicist involved in the development of the atomic fission bomb and a co-recipient of the Nobel Prize in Physics in 1963 for her work on the structure of atomic nuclei. She received her doctorate in 1930 from the University of Göttingen, which attracted many theoretical physicists of the era, but had few women faculty. In Göttingen, she met American chemistry student Joseph Mayer, and the two married in 1930. She came to the United States when her husband accepted a faculty position at Johns Hopkins, but due to anti-nepotism rules at that time, she was not able to secure a faculty position and

worked as a research assistant and even translator for another professor until the couple moved to Columbia University in New York, where she was a lecturer in chemistry. It was in New York that she met Enrico Fermi, another Nobel Prize-winning physicist who was working on nuclear fission and radioactivity, research projects of increasing interest to the U.S. government. She joined Fermi's research team in an unpaid position and in 1942 began to work on top-secret bomb research as part of the Manhattan Project. As the United States had entered World War II, there was a shortage of male scientists, and many women were hired for the project. She was ambivalent about even her small contribution to work on the bomb, but even after the war she made visits to continue work on its development at Los Alamos, New Mexico.



Maria Goeppert-Mayer was co-recipient of the 1963 Nobel Prize in Physics for her work on atomic nuclei. (Nobel Foundation)

After the war, she was offered an associate professorship in physics at Fermi's new Institute of Nuclear Studies at the University of Chicago, and was also a senior physicist at Argonne National Laboratory studying the nuclei of certain elements. It was through this research that she developed her shell model for electron movement around the nucleus, the subject of her 1949 joint publication with J. Hans D. Jensen, which led to their sharing of the Nobel Prize in 1963. Despite this work, and building a prominent reputation as a nuclear physicist beginning in the 1940s, it was not until 1959 that she began to earn a full professor's salary at Chicago. In 1960, both she and her husband were recruited for faculty positions at the University of California, San Diego.

Goeppert-Mayer was elected to the Heidelberg Academy of Sciences (1950) and National Academy of Sciences (1956). She was a member of the American Academy of Arts and Sciences and the American Physical Society, which presents the Maria Goeppert-Mayer Award to a woman physicist each year. She co-authored two books: *Statistical Mechanics* (1940, with Joseph Mayer) and *Elementary Theory of Nuclear Shell Structure* (1955, with J. Hans D. Jensen).

Further Resources

- Byers, Nina and Gary A. Williams. 2006. *Out of the Shadows: Contributions of Twentieth-Century Women to Physics*. New York: Cambridge University Press.
- Opfell, Olga S. 1986. *The Lady Laureates: Women Who Have Won the Nobel Prize*. Metuchen, NJ: Scarecrow Press.

Goldberg, Adele

b. 1945

Computer Scientist, Information Technologist

Education: B.A., mathematics, University of Michigan; M.S. and Ph.D., information science, University of Chicago, 1973

Professional Experience: researcher, educational technology, Stanford University; research scientist, Xerox Corporation, Palo Alto Research Center (PARC), 1973–1988; founder, president, and CEO, ParcPlace Systems, 1988–1992, chair, board of directors, 1992–1996; independent researcher, computer science, 1996–; co-founder, Neometron, 1997–

Adele Goldberg is one of the few women whose contributions to the development of the personal computer in the 1970s is generally acknowledged. With advanced degrees in information technology, she was teaching at Stanford University when Alan Kay, a computer programmer at Xerox Corporation's prestigious think tank, the Palo Alto Research Center (PARC), contacted her about developing a program he called Smalltalk, intended to improve productivity and communication through a simple programming language. Goldberg wrote up demonstrations and tests for the software. Xerox already had an "object-oriented" computer called Star that used icons, windows, and the mouse, but had let it languish in the lab, and competitors brought those ideas to the market. Smalltalk had many of the same features, but Goldberg persuaded Xerox to allow her and her partners to form a subsidiary to market Smalltalk, and in 1988, she and Kay formed ParcPlace Systems. Understanding the importance of user interaction, and with her contacts in the education community, she and Kay brought the program into public schools to have children and teachers use it to develop class projects.

Smalltalk was easier and faster to learn than other programming languages, such as C++ or COBOL, and designed to be used with both mainframes and personal computers. The applications were limitless: business processes, games, educational interactions, document publishing, and manufacturing control. ParcPlace

Systems went public in 1994, and Goldberg resigned as chair of the board soon after. She became an independent researcher and consultant on computer science courses and multimedia software applications for science education. In 1997, she co-founded Neometron, a company creating networking and virtual community computer products for businesses and educational institutions.

Goldberg has published articles and several books: *Smalltalk-80: The Interactive Programming Environment* (1984), *Smalltalk-80: The Language and Its Implementation* (1983), and *Succeeding with Objects: Decision Frameworks for Project Management* (1995). She was awarded the Association for Computer Machinery's Software Systems Award (1987) jointly with several colleagues. She is a member of the Association for Computing Machinery (and one of the few women presidents of that organization, serving from 1984 to 1986) and the American Federation of Information Processing Societies. In 1990, she won the Lifetime Achievement Award from *PC Magazine*.

Further Resources

"Neometron, Inc." <http://www.neometron.com>.

Goldhaber, Gertrude Scharff

1911–1998

Physicist

Education: Ph.D., physics, University of Munich, 1935

Professional Experience: research associate, physics, Imperial College, University of London, 1935–1939; research physicist, University of Illinois, Urbana, 1939–1948, special research assistant professor, physics, 1948–1950; consultant, Brookhaven National Laboratory, 1948–1950, associate physicist to physicist, 1950–1962, senior physicist, 1962–1979

Concurrent Positions: consultant, Argonne National Laboratory, 1946–1950; consultant, Los Alamos Scientific Laboratory, 1953–1979; adjunct professor, Cornell University, 1980–1982; adjunct professor, Johns Hopkins University, 1982

Gertrude Goldhaber had a long and influential career in nuclear physics with significant contributions to research on spontaneous fission neutrons and the identification of beta-rays with atomic electrons. She was involved at Brookhaven

National Laboratory in both theoretical and experimental work to determine the detailed properties of nuclear energy levels and magnetic moments. After receiving a doctorate in physics from the University of Munich in 1935, soon after Hitler came to power, she was able to leave Germany for a position as a research associate in physics at Imperial College, University of London, where she remained for five years. Both of her parents remained in Germany and were killed in the Holocaust. Moving to the United States with her husband, physicist Maurice Goldhaber, in 1939, she was a research physicist studying nuclear physics at the University of Illinois from 1939 to 1950. Both she and her husband were appointed to the staff at Brookhaven National Laboratory in New York in 1950, and she achieved the rank of senior physicist, working at that level from 1962 to 1979. Even after her formal retirement, she continued her research under grants with other colleagues from various institutions and also served as an independent consultant. Undoubtedly inspired by the work and success of their parents, both of her children went on to receive doctorates in theoretical physics.

Goldhaber was elected to the National Academy of Sciences in 1972. She held several prestigious national appointments, including as a member (1959-1964) and chair (1969-1971) of the National Research Council (NRC) advisory panel on the nuclear data project. At the NRC, she also worked on issues related to women in science. She was a member of the board of trustees, Fermi National Accelerator Laboratory (1972-1977), member of the research advisory committee for the National Science Foundation (1972-1974), and member of the nominating committee for the Presidential Medal of Science (1977-1979). She was elected a fellow of both the American Association for the Advancement of Science and the American Physical Society.

Further Resources

Byers, Nina and Gary A. Williams. 2006. *Out of the Shadows: Contributions of Twentieth-Century Women to Physics*. New York: Cambridge University Press.

Goldman-Rakic, Patricia

1937 2003

Neurobiologist

Education: B.A., psychology, Vassar College, 1959; Ph.D., psychology, University of California, Los Angeles, 1963

Professional Experience: U.S. Public Health Service postdoctoral fellow, psychiatry, Brain Research Institute, University of California, Los Angeles (UCLA),

1963–1964; postdoctoral trainee, psychiatry, New York University, 1964–1965; research associate, American Museum of Natural History, 1964–1965; staff fellow, neuropsychology, National Institute of Mental Health, Maryland, 1965–1968, research physiologist, 1978, chief, developmental neurobiology, 1978–1979; professor, neuroscience, Yale University School of Medicine, 1979–2003

Concurrent Positions: visiting scientist, Massachusetts Institute of Technology (MIT), 1974–1975; professor (joint appointments), neurology, psychiatry, and psychology, Yale University School of Medicine, 1991–1996

Patricia Goldman-Rakic was a neuroscientist whose pioneering research in the early 1970s provided the first biological map of the structure of the brain's frontal lobe area. Her work as a neurobiologist combined multidisciplinary methods and approaches from neuroscience, psychiatry, psychology, biology, and biochemistry to understand memory, behavior, and the effect of drugs on the brain. Her work provided insight and implications for further research into mental disorders and diseases such as schizophrenia, depression, cerebral palsy, Parkinson's disease, Alzheimer's, and memory loss. A professor of neuroscience at Yale University Medical School, her research using trained rhesus monkeys (whose brains are most similar to humans) was funded by the National Institute of Mental Health (NIMH) for 20 years (1980–2000).

Goldman attended Vassar College and earned a doctorate in psychology from UCLA in 1963. She held postdoctoral and staff positions at the UCLA Brain Research Institute, New York University, and spent 14 years at NIMH, where she rose to chief of developmental neurobiology before joining the faculty at Yale in 1979. In the early 1970s, she met Pasko Rakic, a developmental biologist then at Harvard Medical School also working on primate brain development. In 1977, the two were married and Pasko Rakic was recruited as head of neuroanatomy at Yale. Goldman-Rakic made a decision to leave her senior-level job as a scientist at NIMH and accept an academic position at Yale, where the two collaborated on their research and founded and co-edited the neuroscience journal *Cerebral Cortex*. Unfortunately, Patricia Goldman-Rakic's career and life were cut short when she was struck by a car and killed in 2003 at the age of 66.

Goldman-Rakic was elected to the National Academy of Sciences in 1990 and was a fellow of the American Academy of Arts and Sciences and the American Psychological Association. Her numerous awards and honors included the Alden Spencer Award from Columbia University (1982), Krieg Cortical Discoverer Award of the Cajal Club (1989), Fyssen Foundation Prize in Neuroscience (1990), Lieber Prize of the National Alliance for Research on Schizophrenia and Depression (1991), Robert J. and Claire Pasarow Foundation Award (1993), Karl Lashley Award of the American Philosophical Society (1996), and Gerard

Prize of the Society for Neuroscience (2002). In 2000, she was awarded an honorary doctorate from Utrecht University, Netherlands. She was a member of the National Advisory Council of the National Institute on Aging, was on the Board of Governors of the Weizmann Institute, and served as president of the Society for Neuroscience (1989–1990).

Further Resources

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

“Patricia Goldman-Rakic: 1937–2003.” Oxford Journals. *Cerebral Cortex*. http://www.oxfordjournals.org/our_journals/cercor/memorial.html.

Goldring, Winifred

1888–1971

Paleontologist

Education: A.B., Wellesley College, 1909; A.M., 1912; student, Teachers School of Science (affiliated with the Boston Society of Natural History), 1909–1911; Harvard University, 1910–1911; Columbia University, 1913; Johns Hopkins University, 1921

Professional Experience: assistant, geology and geography, Wellesley College, 1909–1912; instructor, Teacher’s School of Science, Boston, 1912–1914; expert, New York State Museum, 1914–1915, assistant to associate paleontologist, 1915–1925, paleobotanist, 1925–1939, State Paleontologist, 1939–1950

Winifred Goldring was one of the earliest professional female paleontologists and was recognized for her expertise by being appointed state paleontologist of New York. She received her bachelor’s and master’s degrees from Wellesley and began her career as a teacher at Wellesley before going on to work as a resident expert and then paleontologist at the New York State Museum. Her father had been an orchid grower, and her primary research was actually in paleobotany, with the study of sea lilies from the middle of the Paleozoic era. This was conducted at a time when there was a great deal of interest in paleobotany, and her collection was recognized worldwide. She prepared numerous handbooks, but her most important monograph was *The Devonian Crinoids of the State of New York* (1923), a study of the fossils and geology of the New York area of 345 to 395 million years ago. This was the subject of one of her most successful museum

displays. She went on to publish numerous other books and articles, many of which helped popularize geology for the general public, including *Handbook of Paleontology for Beginners and Amateurs; Part 1, The Fossils* (1929) and *Part 2, The Formations* (1931). Her handbooks and exhibitions were widely copied and considered models for teaching. For example, her “Guide to the Geology of John Boyd Thacher Park” (1933) was a case study well-suited to college courses. In 1939, she was officially appointed state paleontologist, achieving some fame as the first woman to hold the post. She held this position until her retirement in 1950.

Goldring continued her education with postgraduate courses at several universities and received honorary degrees from Russell Sage College (1937) and from Smith College (1957). She was the first woman elected president of the Paleontological Society in 1949 and was also a fellow and one-time vice president of the Geological Society of America. She was also a member of the American Association for the Advancement of Science, the New York Academy of Sciences, and the American Geophysical Union. The Association for Women Geoscientists presents its annual Winifred Goldring Award to a female undergraduate or graduate student planning to pursue a career in paleontology.

Goldwasser, Shafrira

b. 1958

Computer Scientist, Electrical Engineer

Education: B.S., mathematics, Carnegie Mellon University, 1979; M.S., computer science, University of California, Berkeley, 1981, Ph.D., computer science, 1983

Professional Experience: professor, Massachusetts Institute of Technology (MIT), 1983–1997, RSA Professor of Electrical Engineering and Computer Science, 1997–

Concurrent Positions: professor, mathematical sciences, Weizmann Institute of Science, Israel

Shafrira “Shafi” Goldwasser is an electrical engineer and computer scientist known for her work in complexity theory, computational number theory, probability and randomness, cryptography, and zero-knowledge proofs. These are mathematical models and theories used in the creation of secure computer networks and systems, including the transmission of secure information over the Internet.

She studied mathematics as an undergraduate at Carnegie Mellon University and received her doctorate in computer science from the University of California, Berkeley. She has been affiliated with MIT since 1983, except for a brief tenure at the Weizmann Institute of Science in Israel in the early 1990s. At MIT, she teaches electrical engineering and computer science, and is affiliated with MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL).

Goldwasser was elected to the National Academy of Sciences in 2004 and the National Academy of Engineering in 2005. She is a fellow of the American Academy of Arts and Sciences and the International Association for Cryptologic Research (IACR). She received the Presidential Young Investigator Award from the National Science Foundation (NSF) (1987) and an NSF Faculty Award for Women (1991), as well as the Grace Murray Hopper Award of the Association for Computing Machinery (1996), RSA Prize for Mathematics (1998), and Levenson Prize for Mathematics, and she has been awarded the Godel Prize in theoretical computer science twice (1993 and 2001).

Further Resources

Massachusetts Institute of Technology Computer Science and Artificial Intelligence Laboratory. Faculty website. <http://www.csail.mit.edu/user/733>.

Good, Mary (Lowe)

b. 1931

Inorganic Chemist, Radiation Chemist

Education: B.S., Arkansas State Teachers College (now University of Central Arkansas), 1950; M.S., University of Arkansas, 1953, Ph.D., inorganic chemistry and radiation chemistry, 1955

Professional Experience: instructor to assistant professor, chemistry, Louisiana State University, Baton Rouge, 1954–1958; associate professor to professor, chemistry, Louisiana State University, New Orleans, 1958–1980; vice president and director of research, UOP, Inc., 1980–1985; director of research, Signal Research Center/AlliedSignal, Inc., 1985–1986, president, engineering materials research, 1986–1988; senior vice president, technology, AlliedSignal Research and Technology Laboratory, 1988–1993; Undersecretary for Technology, U.S. Department of Commerce, 1993–1997; professor and dean, Donaghey College of Engineering and Information Technology, University of Arkansas, Little Rock, 1997–

Mary L. Good was one of the first chemistry researchers to apply Mossbauer spectroscopy to basic chemical research, namely, the solution of solid-state chemistry problems. Her early work in solvent extraction of metal complexes was focused on describing the chemical and physical properties of chemical species in an organic solvent, and her significant work in this area demonstrated that detailed chemical and structural information could be obtained for systems containing ruthenium. She also worked on the chemical evaluation of antifouling coatings, which are used to remove barnacles from ships in the U.S. Navy and the maritime industry.

Good has achieved prominence for her research and teaching in academia and her administrative capabilities in industry and the federal government. She taught chemistry and was director of the radiochemistry laboratory at Louisiana State University (LSU) at Baton Rouge before joining the chemistry faculty at the new branch of LSU in New Orleans, where her husband, Bill Good, taught physics. In 1980, she made a career change into private industry as a researcher. In 1993, she was appointed by President Clinton as Undersecretary for Technology for the U.S. Department of Commerce. In this position, she was head of the National Institute of Standards and Technology and the National Technology Information Service. She also oversaw the clean-car initiative between the “Big Three” auto manufacturers and the government to develop a car that is capable of operating at 82 miles per gallon. She returned to teaching in 1997 and helped found the College of Information Science and Systems Engineering at the University of Arkansas. She is the author of *Integrated Laboratory Sequence* (1970) and *Biotechnology and Materials Science: Chemistry for the Future* (1988).

Good has received more than 20 honorary degrees and was appointed to the National Science Board in 1980 and again in 1986. She was elected to membership in the National Academy of Engineering in 1987. She served on the President’s Council of Advisors on Science and Technology 1991, a group that guides and shapes U.S. scientific policy. She has been president of the Zonta International Foundation, part of a multinational organization dedicated to improving the status of women by encouraging high ethical standards in business and supporting women in science studies. She received the Garvan Medal of the American Chemical Society (ACS) (1973) and was chair and later president of the ACS (1987). Good also received the Parsons Award of the ACS (1991), the first woman to receive this recognition for outstanding public service by an ACS member, and was named scientist of the year by *Industrial Research & Development* in 1982. In 1992, she received a Distinguished Public Service Award from the National Science Foundation (NSF), and in 2004, she received the Vannevar Bush Award of the NSF.

Further Resources

University of Arkansas, Little Rock. “George W. Donaghey College of Engineering and Information Technology, Dean’s Office.” http://technologize.ualr.edu/?page_id=6.

Goodenough, Florence Laura

1886–1959

Psychologist

Education: B.Pd., pedagogy, Pennsylvania State Normal School, Millersville, 1908; B.S., Columbia University, 1920, A.M., 1921; Ph.D., psychology, Stanford University, 1924

Professional Experience: public school teacher, 1908–1921; research assistant, gifted children survey, Stanford University, 1921–1924; psychologist, Minneapolis Child Guidance Clinic, 1924–1925; assistant professor, Institute of Child Welfare, University of Minnesota, 1925–1931, professor, 1931–1947, emerita, 1947–1959

Florence Goodenough was a researcher of human psychological development, mental tests, general psychological experimentation, and free-word association. She made important contributions to the development of tools for the measurement and interpretation of intelligence in children. She is best known for the creation of the Draw-A-Man (or Draw-A-Person, “DAP”) Test. In the DAP test (later known as the Goodenough-Harris Drawing Test), the psychologist asks a child to draw several figures and then interprets the drawings for assessment of various emotional and cognitive issues and skills. In addition to her numerous scientific papers and articles, she authored or co-authored several books, including *Genetic Studies of Genius* (1925), *Measurement of Intelligence by Drawings* (1926), *Handbook of Child Psychology* (1931), *Mental Testing: Its History, Principles, and Applications* (1949), and *Exceptional Children* (1956).

Goodenough taught school for more than 10 years while she pursued her undergraduate college degrees. At Columbia University, she worked with **Leta Stetter Hollingworth** and, moving from the East Coast to California to earn her doctorate at Stanford, she studied under pioneer educational psychologist and eugenicist Lewis Terman, who created the Stanford-Binet IQ test. Goodenough was able to participate in innovative studies of IQ and mental measurements being conducted under Terman in the 1920s. She joined the faculty of the Institute for Child Welfare at the University of Minnesota, where she experimented with several methods of

measuring mental ability, including the Minnesota Preschool Scale, which was subsequently widely used. In her research and writing, she stressed that IQ is not constant and may be influenced by environmental factors, and that children should not be labeled at an early age. She urged the study of the total life span at a time when most studies of intelligence stopped after adolescence.

Goodenough was elected president of the National Counsel of Women Psychologists in 1942 and president of the Society for Research in Child Development in 1947.

Gordon (Moore), Kate

1878 1963

Psychologist

Education: Ph.B., University of Chicago, 1900, Ph.D., 1903

Professional Experience: instructor, philosophy, Mount Holyoke College, 1904–1905, associate professor, psychology, 1905–1906; instructor, educational psychology, Teachers' College, Columbia University, 1906–1907; associate professor, psychology, Bryn Mawr College, 1912–1916; assistant to associate professor, psychology and education, Carnegie Institute of Technology, 1916–1921; lecturer, psychology, University of California, Los Angeles, 1921–1922, associate professor, 1923–1934, professor, 1934–1948

Kate Gordon was among the first generation of American women psychologists, and her research focused on the areas of educational psychology, memory, attention, imagination, and the aesthetics of color. She published on the topic of our ability to remember experiences, both good and bad, disagreeing with Freud's theory that we forget or repress difficult or negative experiences. Her interest in memory led to her work as a consultant on educational and ability testing, a popular topic for psychologists of the 1920s and 1930s. Gordon differed from others in her field, however, due to her interdisciplinary interest in how memory and imagination influence aesthetic tastes in art and music, for example. After she received her doctorate from the University of Chicago, Gordon moved frequently from one appointment to another, teaching in psychology, education, and philosophy at Mount Holyoke, Columbia, Bryn Mawr, and Carnegie Institute of Technology. She also lectured on gender differences, and in 1905 promoted the co-education of men and women in an essay considering "Wherein Should the Education of a Woman Differ from That of a Man." Gordon argued that "it would seem to me both frivolous and morally wrong for a school or college to spend time, money

and intelligence in devising different systems of training for the two sexes, while so many, and those so real, problems in education are waiting for solution.” In the 1920s, she was a consultant to the California State Board of Control on mental testing in the schools. Around the same time, she accepted a lectureship in psychology at the University of California, Los Angeles (UCLA), where she became a full professor in 1934.

Gordon was a member of several scientific societies, including the American Association for the Advancement of Science, the American Psychological Association, the American Philosophical Association, and the Western Psychological Association, for which she served a term as president. She married late in life, at age 65, to education professor and one of the founders of UCLA, Ernest Carroll Moore, and after that time was known by her husband’s last name.

Further Resources

University of California. “Kate Gordon Moore, Psychology: Los Angeles.” <http://content.cdlib.org/xtf/view?docId=hb338nb1j4&doc.view=frames&chunk.id=div00014&toc.depth=1&toc.id=&brand=oac>.

Gordon, Ruth Evelyn

1910 2003

Bacteriologist

Education: B.A., chemistry, Cornell University, 1932, M.S., 1933, Ph.D., bacteriology, 1934

Professional Experience: instructor, New York Veterinary College, Cornell University, 1934–1938; assistant bacteriologist, Division of Soil Microbiology, U.S. Department of Agriculture, 1939–1942, bacteriologist, 1950–1951; Army Medical Center, 1943–1945; bacteriologist and curator, American Type Culture Collection, 1946–1951; associate research specialist, New Jersey Agricultural Experiment Station, 1951–1954; associate professor, Waksman Institute of Microbiology, Rutgers University, 1954–1971, professor, microbiology, 1971–1981; visiting investigator, American Type Culture Collection, 1981–2003

Ruth Gordon was a well-known bacteriologist and taxonomist for the American Type Culture Collection. After high school, she received a fellowship to attend Cornell University, where she received a bachelor’s degree in chemistry and a master’s degree and then doctorate in bacteriology. She first was employed as an instructor at the New York Veterinary College at Cornell University studying cattle

and soil bacteria, the taxonomy of aerobic spore-forming bacteria, and streptomycetes, which became her area of expertise. This led to a varied career of employment with the U.S. Department of Agriculture (USDA), an army medical center, an agricultural experiment station, and in academia. At the USDA, she was a bacteriologist of soil microbiology and, in 1946, published a study of the genus *Bacillus* that went through subsequent updated editions.

During World War II, she was employed at the U.S. Army Medical Center studying bacterial meningitis and, after the war, accepted a position as a bacteriologist at the American Type Culture Collection, being promoted to curator in 1947. She became an associate research specialist at the New Jersey Agricultural Experiment Station, then moved to the faculty of new Waksman Institute of Microbiology at Rutgers, where she oversaw the collection of bacteria and was promoted to full professor in 1971. After her formal retirement in 1981, she returned to the American Type Culture Collection as a visiting investigator, overseeing further development and recording of the bacterial collection. The bacteria genus, *Gordona* (of family *Gordoniaceae*) is named after her.

Gordon received the J. Roger Porter Award from the U.S. Federation for Culture Collections (1983) and the Alice Evans Award of the American Society for Microbiology (1992). She had an international reputation and was Honorary President of the International Symposium on the Biology of Actinomycetes held in Venezuela (1974) and again in Germany (1979). She was a member of the American Association for the Advancement of Science, the Tissue Culture Association, the Canadian Society of Microbiologists, and the U.S. Federation for Culture Collections.

Further Resources

"In Memoriam: Ruth Evelyn Gordon (1910-2003)," United States Federation for Culture Collections (USFCC). *Newsletter*. 32(2). (2003). <http://www.usfcc.us/newsPdfs/USFCC322.pdf>.

Graham, Frances (Keesler)

b. 1918

Psychophysicologist

Education: B.A., Pennsylvania State University, 1938; Ph.D., psychology, Yale University, 1942

Professional Experience: assistant and instructor, medical psychology, Washington University, St. Louis, 1941–1948, research associate, 1953–1957; instructor,

psychology, Barnard College, 1948–1951; independent researcher, 1951–1957; research associate, University of Wisconsin, Madison, 1957–1964, associate professor to professor, pediatrics, 1964–1980, professor, psychology, 1969–1986; research professor, psychology, University of Delaware, 1986–retired

Concurrent Positions: psychologist and acting director, St. Louis Psychiatric Clinic, 1942–1944

Frances Graham is known for her research on the psychology of attention and the use of physiological measurement in the study of cognition and perception. A leading developmental psychologist, she has advanced psychological knowledge of the first months of life and been instrumental in developing measures and analyses for this field. As an undergraduate at Pennsylvania State University, she was a mathematics major until a required course in psychology steered her in another direction. In her graduate program at Yale, she first explored child clinical work.

After her marriage in 1941, she moved to St. Louis, where she held positions in a city clinic and at Washington University. She negotiated working half a day per week for research and developed a memory-for-designs test for brain damage that is still used today. While her husband, David Graham, was at Cornell Medical College from 1948 to 1951, Graham taught at Barnard College. When they returned to the St. Louis area, she decided to be a self-supporting research investigator. She obtained grants to study the consequences of low blood oxygenation during the first postnatal hour, which eventually played a pivotal role in prenatal risk research.

In 1957, the Grahams moved to the University of Wisconsin, Madison, where she received an appointment as a research associate in pediatrics. In 1964, when she received a National Institute of Mental Health Research Scientist Award, she also became a tenured associate professor. She was promoted to professor of pediatrics in 1968 and received a joint appointment in psychology in 1969. Since the Research Scientist Award paid her salary, she was able to teach and at the same time explore the electronics equipment available for research. She discovered that an unexpected stimulus change results in a slower cardiac rate, and other research efforts centered on the blink reflex of the human eye. In 1986, the Grahams moved to the University of Delaware, where Frances received a full-time appointment in psychology. Her research there has centered on cardiac orienting and reflex modulation.

Graham has received numerous awards, including the Distinguished Scientific Contribution of the Society for Psychophysiological Research (1981) and the Distinguished Alumna Award from Pennsylvania State University (1983). She was the Hilldale Research Professor at the University of Wisconsin and was named a William James fellow of the American Psychological Society in 1990.

She was a consultant to both the National Institute of Neurological Disease and Blindness (1958–1970) and the President’s Commission on Ethics in Medicine and Biomedical and Behavioral Research (1979–1981). She received the Wilbur L. Cross Medal of Yale University (1992) and the Gold Medal for Lifetime Achievement from the American Psychological Association (1995).

Graham was elected to membership in the National Academy of Sciences in 1988 and is a fellow of the American Association for the Advancement of Science. She is a member of the Society for Psychophysiological Research (president, 1974), Society for Research in Child Development (president, 1975–1977), American Psychological Association, Federation of Behavior Psychological and Cognitive Sciences, Acoustical Society of America, International Society for Developmental Psychobiology, and Society of Experimental Psychologists.

Further Resources

O’Connell, Agnes N. and Nancy Felipe Russo, eds. 1988. *Models of Achievement: Reflections of Eminent Women in Psychology*. Vol. 2. Hillsdale, NJ: Lawrence Erlbaum Associates.

Graham, Norma

b. 1944

Psychologist

Education: B.S., mathematics, Stanford University, 1966; Ph.D., psychology, University of Pennsylvania, 1970

Professional Experience: postdoctoral fellow, visual neuroscience, Rockefeller University, 1970–1972; assistant professor, psychology, Columbia University, 1972–1976, associate professor, 1976–1982, professor, 1982–, chair, 2007–

Norma Graham is a psychologist who studies visual behavior and perception, in particular texture-segregation, pattern recognition, multiple channels of spatial frequency, and light and contrast adaptations. Graham studied mathematics at Stanford University and went on to receive her Ph.D. in psychology from the University of Pennsylvania. After completing her doctorate in 1970, she held a postdoctoral fellowship in visual neuroscience at the Rockefeller University. She joined the faculty in psychology at Columbia University in New York in 1972, where she has remained for her entire career. Working closely and co-publishing with her Columbia colleague, research scientist Sabina Wolfson, Graham uses mathematical or computational models to understand behavioral and

neurophysiological responses to visual stimuli and change. Her textbook, *Visual Pattern Analyzers* (1989; paperback ed., 2001), synthesizes the work of many researchers for students of vision and perception across disciplines in the fields of psychophysics, neuroscience, ophthalmology and optics, and cognitive and experimental psychology. Graham has also been on the editorial boards of *Journal of Vision* and *Spatial Vision*.

Graham was elected to the National Academy of Sciences in 1998 and is a fellow of the Optical Society of America, American Academy of Arts and Sciences, Society of Experimental Psychologists, and American Psychological Association. She was the recipient of a Cattell Sabbatical Award and a Guggenheim Fellowship (1979–1980).

Further Resources

Columbia University. Faculty website. <http://www.columbia.edu/~nvg1/index.html>.

Graham, Susan Lois

b. 1942

Computer Scientist

Education: B.A., mathematics, Harvard University, 1964; M.S., computer science, Stanford University, 1966, Ph.D., computer science, 1971

Professional Experience: associate research scientist and adjunct assistant professor, computer science, Courant Institute of Mathematical Science, New York University, 1969–1971; assistant to associate professor, electrical engineering and computer science, University of California, Berkeley, 1971–1981, professor, 1981–

Concurrent Positions: lecturer, IBM Canada Laboratory, 1988–1992; visiting professor, Computer Science Department, Stanford University, 1981, lecturer, 1993

Susan Graham is known for her expertise in programming language design and implementation, syntax error recovery, parsing, and code generation and optimization. Her primary research projects have involved programming languages for very large systems and networks. This work involves compiler transformations for high-performance computing, developing languages and interactive software, detecting faults in software, orchestrating interactions among parallel computations, and the design and implementation of practical data breakpoints. She has

consulted with IBM training programmers in setting up or repairing computer networks when program glitches disrupt service. Her expertise has also been sought by government agencies, including an appointment to the President's Committee on the National Medal of Science (1994–1996), which recommends the persons to receive the medal, and the President's Information Technology Advisory Committee. She served on the National Science Foundation (NSF) advisory committee on Computer and Computation Research (1987–1992); served as advisor for the NSF program for science and technology centers (1987–1991); was a member of the National Research Council's committee on physical science, mathematics, and applications (1992–1995); and was co-chair of the National Research Council's study on the Future of Supercomputing. Several universities have sought her expertise in evaluating their science curricula, and she was a member of the visiting committee for applied sciences at Harvard University (1995) and of the visiting committee for engineering and applied science at the California Institute of Technology (1994).

Graham was elected to membership in the National Academy of Engineering in 1993. She was honored with the Special Interest Group on Programming Languages (SIGPLAN) Career Programming Language Achievement Award (2000) and the Distinguished Service Award (2006), both from the Association for Computing Machinery (ACM). She was founding editor of ACM's *Transactions on Programming Languages and Systems* (1978–1992) and also served as editor of *Communications of the Association for Computing Machinery* (1975–1979). She is a fellow of the American Association for the Advancement of Science and the American Academy of Arts and Sciences, and a member of the Institute of Electrical and Electronics Engineers.

Further Resources

University of California, Berkeley. Faculty website. <http://www.eecs.berkeley.edu/Faculty/Homepages/graham-s.html>.

Grandin, Temple

b. 1947

Animal Scientist

Education: B.A., psychology, Franklin Pierce College, 1970; M.S., animal science, Arizona State University, 1975; Ph.D., animal science, University of Illinois, Urbana, 1989

Professional Experience: livestock editor, *Arizona Farmer Ranchman*, 1973–1978; equipment designer, Corral Industries, Phoenix, Arizona, 1974–1975; founder and consultant, Grandin Livestock Systems, 1975–; lecturer to professor, animal sciences, Colorado State University, 1990–

Concurrent Positions: chair, handling committee, Livestock Conservation Institute, Madison, Wisconsin, 1976–1995

Temple Grandin is an animal scientist who specializes in designing equipment for handling livestock on farms, in feedlots, and in slaughtering facilities. Grandin was diagnosed with autism as a child, and eventually her curiosity about her own condition and sensory issues led to her scientific inquiries into animal behavior. As a teenager, she visited her aunt’s farm and noticed that the workers were using a “squeeze chute” to keep cattle calm while inoculating them. Grandin persuaded her aunt to let her try the chute, and at home built her own model chute from cardboard and plywood. As an autistic person she did not like close contact with others, including being hugged or embraced, or even shaking hands. However, Grandin found that the chute relaxed her and gave her a sense of security that human contact could not. In college, a psychologist doubted her theory, but she persuaded 40 students to try the chute, and 25 found it relaxing.

The experience with the squeeze chute led to her career in designing more humane equipment and facilities to keep livestock safe and minimize their stress. In the 1990s, Grandin began consulting for the fast-food industry, which was under attack from animal-rights groups about inhumane farming practices. She visited feedlots and slaughterhouses, and created the idea of a circular or curved chute to guide cattle through the process rather than the standard straight shoots. The sides of the chutes were six feet high and the walls so thick that the cattle would not be disturbed by the sights and sounds of the workers or the equipment. Companies that implemented her design, such as McDonald’s, reported that the cattle were calmer and hesitated less as they moved through the chutes, and therefore overall efficiency improved. Many of Grandin’s guidelines for humane slaughter have been adopted industrywide. In her 2005 book *Animals in Translation: Using the Mysteries of Autism to Decode Animal Behavior*, Grandin explains that she identifies with animals because, as an autistic person, she has difficulty understanding emotions or reading body language in others and her emotions are more directly tied to her physical surroundings. Some have wondered why she works so closely with the meat industry rather than promoting vegetarianism, but Grandin’s only goal is for humans to treat animals with respect: “We owe them a decent life and a decent death, and their lives should be as low-stress as possible.”

Grandin has become not only a public spokesperson for animal rights, but also a role model in her efforts to raise public awareness about the unique experiences

Women and Autism

In 2013, the next update of the *Diagnostic and Statistical Manual of Mental Disorders (DSM V)*, the guidebook used by mental-health practitioners, will include changes to the definition and diagnosis of Asperger's syndrome and autism. Autism was first included in the *DSM* in 1952, but since that time, the definition has been revised as new medical research and social conditions have expanded the diagnosis to include a range of "spectrum" disorders. Although changes to the *DSM* are always controversial, researchers are proposing to simplify diagnosis and treatment of a range of behavioral issues that are overwhelmingly diagnosed in boys. Some practitioners and advocates have begun to question whether girls with autism might go undiagnosed because of a gendered view of certain behaviors. For example, girls might be expected to have stronger imaginations or be more socially withdrawn, and thus potential early signs of autism might be ignored. In 2010, HBO aired a full-length dramatized film about the life of animal scientist Temple Grandin, perhaps the most famous adult woman with autism. While her own early connection with animals was not seen as unusual behavior for a young girl, Grandin warns that autism changes over time and an early childhood diagnosis need not seal a child's fate.

and talents of autistic persons. She has written about her own life and experiences as an autistic person in two autobiographies: *Emergence: Labeled Autistic* (1986) and *Thinking in Pictures and Other Reports from My Life with Autism* (1993). And she has co-authored books specifically for autistic people, such as *Developing Talents: Careers for Individuals with Asperger Syndrome and High-Functioning Autism* (2004; co-authored with Kate Duffy) and *Unwritten Rules of Social Relationships* (2005; co-authored with Sean Barron). Neurologist Oliver Sacks's bestselling book *An Anthropologist on Mars* (1995) includes information on Grandin's work.

Grandin has, paradoxically, become a hero of both the meat industry and animal-rights organizations. Among her numerous honors are the Industry Innovator Award from *Meat Marketing and Technology Magazine* (1994, 2001, 2002), American Veterinary Medical Association's Human Award (1999), American Society for the Prevention of Cruelty to Animals Founders Award (1999), Joseph Wood Kruth Medal from the Humane Society (2001), and President's Award from the National Institute of Animal Agriculture (2004). She is a member of the Autism Society of America, American Society of Animal Science, American Society of Agricultural Engineers, and Animal Welfare Committee of the American Meat Institute.

Further Resources

“Temple Grandin, Ph.D.” <http://www.templegrandin.com/>. Colorado State University. Faculty website. <http://lamar.colostate.edu/~grandin/>

Granville, Evelyn (Boyd)

b. 1924

Mathematician, Computer Scientist

Education: B.A., Smith College, 1945; M.A., mathematics and physics, Yale University, 1946, Ph.D., mathematics, 1949

Professional Experience: research assistant, New York University Institute of Mathematics and Mechanics, 1949–1950; associate professor, mathematics, Fisk University, 1950–1952; mathematician, U.S. National Bureau of Standards, 1952–1953; applied mathematician, Diamond Ordnance Fuze Laboratory, U.S. Army, 1953–1956; mathematician, International Business Machines Corporation (IBM), 1956–1960; researcher, Space Technology Laboratories, 1960–1963; research specialist, North American Aviation Space and Information Systems Division, 1963–1967; associate professor to professor, mathematics, California State University, Los Angeles, 1967–1984; professor, mathematics, Texas College, Tyler (later University of Texas, Tyler), 1985–1988, chair and visiting professor, 1990–1997

Evelyn Granville is a mathematician who contributed to the Vanguard and Mercury space programs in analyzing orbits and computing rocket trajectories. In her various industry and government positions, she consulted for ordnance engineers and scientists, analyzing the mathematical problems that arose in the development of missile fuses, and worked on the formulation of orbit computations and computer procedures for space probes. She was a consultant in numerical analysis and a programmer for the IBM 650 and 704 computers before joining U.S. Space Technology Laboratories to participate in research studies on the methods of orbit computation; she became a research specialist for the Apollo Engineering Department in celestial mechanics, trajectory and orbit computation, numerical analysis, and digital computer techniques at North American Aviation’s Space and Information Systems Division.

Granville was only the second African American woman to receive a doctorate in mathematics. She grew up in segregated Washington, D.C., and originally planned to teach high school mathematics and science. She won a partial scholarship to Smith College, and worked summers for the National Bureau of Standards during World War II, when there was an unusual number of job opportunities for women. By the

time she received her doctorate in 1949, however, it was difficult for a woman and an African American to find a position at a university, even though she had a degree from a top university. She taught briefly at Fisk University before moving into government and industry positions for several years, and returned to academia to teach for 30 years in California and Texas.

Granville found that too many students were ill-prepared for higher-level mathematics. She was inspired to improve math education at all levels, teaching in a supplementary school mathematics program and directing an afterschool mathematics enrichment for students in kindergarten through fifth grade. Her commitment to mathematics education included writing a textbook, *Theory and Application of Mathematics for Teachers* (1975), that has had extensive use. She has been active in educational commissions at the state and national levels and is a member of the American Mathematical Society and the Mathematical Association of America. In 1999, she was elected to the National Academy of Sciences, and in 2000, she received the Wilbur Cross Medal from Yale University. She is listed in some sources as “Evelyn Collins” or as “Evelyn Boyd.”

Further Resources

Agnes Scott College. “Evelyn Boyd Granville.” Biographies of Women Mathematicians. <http://www.agnesscott.edu/lriddle/women/granvill.htm>.

Murray, Margaret Anne Marie. 2000. *Women Becoming Mathematicians: Creating an Identity in Post World War II America*. Cambridge, MA: MIT Press.

Grasselli (Brown), Jeanette

b. 1928

Analytical Chemist, Spectroscopist

Education: B.S., chemistry, Ohio University, 1950; M.S., chemistry, Case Western Reserve University, 1958

Professional Experience: chemist and infrared spectroscopist, Research and Development, BP America, Inc. (formerly Standard Oil of Ohio, or Sohio), 1950–1956, project leader, absorption spectroscopy group, 1956–1970, supervisor, molecular spectroscopy, 1970–1981, director, analytical science laboratory, 1981–1983, director, technical support, 1983–1985, director, corporate research and environmental and analytical science, 1985–1989; distinguished visiting professor and director, research enhancement, Ohio University, 1989–1995

Jeanette Grasselli developed new problem-solving techniques in analytical chemistry that solve real-life problems such as identification of contaminants in

gasoline, analyzing the structure of new plastics, and analyzing pollution problems in the environment. During her career, she was responsible for developing many innovative applications for molecular spectroscopy; these applications are now at the forefront of industrial practice. Although spectrometry had been used since the late nineteenth century, it was not until World War II that electronics were developed to make the instrumentation that was necessary to solve complex problems. Spectroscopy is an analytical technique to measure the interaction of electromagnetic radiation with matter. The methods are nondestructive and require only small amounts of sample, thus providing data at the atomic and molecular levels. The instruments are used in solving problems in academia, government, industry, and the environment. She is the author of *The Analytical Approach* (1983) and co-editor of *Atlas of Spectral Data and Physical Constants of Organic Compounds* (2nd ed., 1975) and *Practical Spectroscopy Series*, Vols. 1–3, *Infrared and Raman* (1977).

After graduating from Ohio University with a chemistry degree, she joined BP of America (formerly Standard Oil of Ohio), where she was put in charge of a new instrument called an *infrared spectrometer* and a project to analyze World War II German airplane fuel formulations to see how the Germans were able to obtain such long flight ranges for their planes. She became one of the foremost contributors of the century to infrared and Raman spectrometry, and also used nuclear magnetic resonance spectroscopy to a lesser extent. She even consulted with the coroner's office in Cleveland, Ohio, to analyze unknown samples at crime scenes, as forensic analytical methods are the same as the analytical methods used in industrial laboratories. She found she needed to know more about physical and organic chemistry for her work and enrolled as a part-time student at Case Western Reserve University to earn a master's degree. She worked through the ranks at BP to become the first woman director of corporate research and, when she retired in 1989, she held the highest administrative position of any woman at that company.

Grasselli received the Garvan Medal of the American Chemical Society (ACS) (1986), the Distinguished Service Award of the Society for Applied Spectroscopy (1985), and the Fisher Award in Analytical Chemistry of the ACS (1993). She was named to Ohio Women's Hall of Fame (1989) and was the first woman inducted into the Ohio Sciences and Technology Hall of Fame (1991). She has served on the National Science Foundation Advisory Committee for Analytical Chemistry (1982–1984), the Energy Research Advisory Board of the U.S. Department of Energy (1987–1989), the visiting committee of the National Institute of Standards and Technology (1988–1991), the Smithsonian Institution's exhibition advisory board (1990–1994), and the U.S. National Committee of the International Union of Pure and Applied Chemistry (chair, 1992–1995). She has been active in

promoting careers for women as a member of the International Women's Forum and National Research Council's Committee on Women in Science and Engineering (1995). She is a member of the American Chemical Society, Society for Applied Spectroscopy (president, 1970), Coblentz Society, Federation of Analytical Chemistry and Spectroscopy Societies, and American Association for the Advancement of Science. In 1987, she remarried, to BP colleague Glenn Brown, and is identified in some sources as Jeanette Grasselli-Brown.

Graybiel, Ann Martin

b. 1942

Neuroscientist

Education: B.A., Harvard, 1964; Woodrow Wilson Fellow, biology, Tufts University, 1965–1966; Ph.D., psychology and brain science, Massachusetts Institute of Technology, 1971

Professional Experience: research associate, Massachusetts Institute of Technology (MIT), 1971–1973, assistant professor, psychology, 1973–1976, associate professor, 1976–1980, professor, neuroanatomy, Department of Psychology, 1980–1983, professor, neuroscience, Department of Brain and Cognitive Sciences, 1983–, Walter A. Rosenblith Professor of Neuroscience, 1994–2008, Investigator, McGovern Institute for Brain Research, MIT, 2001–, Institute Professor, 2008–

Concurrent Positions: head, Course in Neuroscience, and professor, Health Sciences and Technology (HST), Harvard Medical School, 1986–1988; affiliate, Picower Center for Learning and Memory, MIT, 2001–

Ann Graybiel is a neuroscientist renowned for her work on the basal ganglia, the area of the brain that controls motor skills and movement, and is affected by diseases such as Parkinson's disease, Huntington's disease, and neuropsychiatric behavioral disorders such as Tourette's syndrome, obsessive-compulsive disorders, depression, and addiction. Graybiel's research depends on a variety of methods to analyze neural pathways through this area, and her work combines the disciplines of neuroanatomy, genetics, and psychiatry.

Graybiel studied biology and chemistry at Harvard and at Tufts University, and received her doctorate in psychology and brain science from MIT in 1971. She continued on as a research associate at MIT and joined the faculty in psychology in 1973. In 1994, she was named Walter A. Rosenblith Professor of Neuroscience in the Department of Brain and Cognitive Sciences. In 2001, she was appointed



Neuroscientist Ann Graybiel receiving the National Medal of Science from President George W. Bush, 2002. (AP/Wide World Photos)

Investigator at the McGovern Institute and was named Institute Professor in 2008. She has been an invited lecturer at national and international institutions and has served on numerous scientific advisory boards, including for the Max Planck Institute for Psychiatry, Germany; Tourette Syndrome Association; United Parkinson's Disease Foundation National Institute of Mental Health; National Advisory Mental Health Council; Hereditary Disease Foundation; Alzheimer Research Forum; Stockholm Brain Institute, Stockholm, Sweden; and many others. She has served on the editorial board of several journals related to neuroscience, mental health, and brain disorders.

Graybiel was honored with the National Medal of Science in 2001. She was elected a member of the National Academy of Sciences in 1988 and the Institute of Medicine in 1994. She is a fellow of the American Academy of Arts and Sciences, American Academy of Neurology, and American College of Neuropsychopharmacology, and an honorary member of the Royal Academy of Medicine, Spain. She served as president of the International Basal Ganglia Society (1997–1998). Among her numerous other honors and awards are a Charles Judson Herrick Award of the American Association of Anatomists (1978), Javits Neuroscience Investigator Awards of the National Institutes of Health (1988 and 1995), an Outstanding Women in Neuroscience Award from Brown University (2001), a James R. Killian, Jr., Faculty Achievement Award from MIT (2002), the Robert S. Dow Neuroscience Award (2002), the MERIT Award of the National Institutes of Health (2004), the Prix Plasticité Neuronale from the IPSEN Foundation (2005), a NARSAD Distinguished Investigator Award (2007), the C. David Marsden Lectureship Award, Movement Disorder Society (2008), and the Vanderbilt Prize in Biomedical Science (2008). She was also named a Woman Leader of Parkinson's Science by the Parkinson's Disease Foundation (2004) and Harold S. Diamond Professor by the National Parkinson Foundation (2006). She has received honorary doctorates from Mount Sinai School of Medicine, New York (2003), Tufts University (2005), Hebrew University, Jerusalem (2007), and Queens University, Belfast (2007).

Further Resources

Massachusetts Institute of Technology. "Graybiel Laboratory." <http://web.mit.edu/bcs/graybiel-lab/index.html>.

Greene, Laura

b. 1952 Physicist

Education: B.S., physics, Ohio State University, 1974, M.S. physics, 1978; M.S., experimental physics, Cornell University, 1980, Ph.D., physics, 1984

Professional Experience: technical staff member, Physics Division, Hughes Aircraft Company, California, 1974–1975; postdoctoral technical staff member, Bell Labs (Bellcore), New Jersey, 1983–1984, technical staff member, Bellcore, 1985–1992; professor, physics, University of Illinois, Urbana-Champaign, 1992–2000, Swanlund Professor of Physics, 2000–

Concurrent Positions: visiting professor, Centre National de Recherche Scientifique (CNRS), Orsay, France, summer 2004

Laura Greene is an experimental physicist whose research focuses on highly correlated electron systems and materials, especially high-temperature superconductors and metallic superconducting devices. She uses a technique called *tunneling spectroscopy* to analyze how electrons are transported across superconducting interfaces. She earned her bachelor's and master's degrees in physics from Ohio State University and went on to Cornell University to earn another master's degree and her doctorate in 1984. She worked in industry, for Bell Laboratories (later Bellcore), and joined the faculty of the University of Illinois, Urbana-Champaign in 1992. In 2000, she was named Swanlund Professor of Physics. She has served on numerous academic and government committees and advisory boards, including the Basic Energy Sciences Advisory Committee of the U.S. Department of Energy and as founding member of the Los Alamos Institute for Complex and Adaptive Materials. She has consulted with the National Science Foundation and Department of Energy on gender equity in the sciences and has been active in educational efforts to encourage students in scientific careers. She is the author or co-author of more than 140 scientific papers and has been an invited lecturer at institutions both nationally and internationally.

Greene was elected to the National Academy of Science in 2006 and is a fellow of the American Physical Society, American Association for the Advancement of Science, American Academy of Arts and Sciences, and Institute of Physics (UK). She is also a member of the American Association of Physics Teachers, International Union of Pure and Applied Physics (IUPAP), Materials Research Society, and American Chemical Society. Her awards and honors include an Award of Excellence from Bellcore (1989), Maria Goeppert-Mayer Award of the American Physical Society (1994), and the E. O. Lawrence Award for Materials Research from the U.S. Department of Energy (1999). In 2001, she was selected for a Women in Science profile by Women in Technology International (WITI).

Further Resources

University of Illinois. Faculty website. <http://physics.illinois.edu/people/profile.asp?lhgreene>.

Women in Technology International. "Laura Greene: Swanlund Professor of Physics University of Illinois at Urbana-Champaign." <http://www.witi.com/center/witimuseum/womeninsciencet/2001/060901.shtml>.

Greer, Sandra Charlene

b. 1945**Physical Chemist**

Education: B.S., chemistry, Furman University, 1966; M.S., physical chemistry, University of Chicago, 1968, Ph.D., chemical physics, 1969

Professional Experience: research chemist, National Bureau of Standards, Maryland, 1969–1978; associate professor, chemistry, University of Maryland, 1978–1983, professor, chemistry and biochemistry, 1983–2008, professor, chemistry and biomolecular engineering, 1995–2008, emerita; provost, dean of faculty, and professor, chemistry and physics, Mills College, 2008–

Concurrent Positions: Professeur Invitée, Université de Paris-Sud, Orsay, France, 1990

Sandra Greer is a physical chemist known for her research in experimental thermodynamics of phase transitions and critical phenomena of fluid mixtures. Thermodynamics is the science concerned with the relations between heat and mechanical energy or work, and the conversion of one into the other. Her major interest is critical phenomena, which is a phase change in which two forms of matter that are very different gradually grow more alike because of temperature and pressure variation. As a child, her parents purchased chemistry sets and a microscope to encourage her interest in science. She received her undergraduate degree in chemistry with a minor in mathematics from Furman University, a small liberal-arts school in South Carolina. She was accepted to graduate study at the University of Chicago, where she received both her master's degree and a doctorate. She married another chemistry graduate student during college, and they both secured positions at the National Bureau of Standards, where she worked in the heat division.



Physical chemist Sandra Greer. (Courtesy of Mills College)

In 1978, Greer left industry to join academia, where she has had a distinguished career as both a faculty member and administrator. She joined the faculty of the University of Maryland as an associate professor in the Department of Chemistry. She was promoted to professor in 1983 and served as department chair from 1990 to 1993. In 1995, she secured a joint appointment in the school of engineering. Her work has been supported by funding from the National Institutes of Health, National Science Foundation, and the Petroleum Research Fund. In 2008, she became provost of Mills College, a liberal-arts college for women in California.

Greer has served as a member, program officer, and advisor for national science programs and university committees focused on science education and career issues for women in science. She has received numerous teaching and research awards from her own university as well as the American Chemical Society's Garvan Medal (2004). Greer is a fellow of the American Physical Society and a member of the American Chemical Society, American Association for the Advancement of Science, Association of Women in Science, and American Institute of Chemical Engineers.

Further Resources

Mills College. "Office of the Provost." http://www.mills.edu/administration/provosts/office/provost_bio.php.

Greibach, Sheila Adele

b. 1939

Computer Scientist, Mathematician

Education: B.A., linguistics and applied mathematics, Radcliffe College, 1960, M.A., 1962; Ph.D., applied mathematics, Harvard University, 1963

Professional Experience: lecturer, applied mathematics, Harvard University, 1963–1965; assistant to associate professor, computer science, University of California, Los Angeles (UCLA), 1969–1972, professor, 1972–

Sheila Greibach is known for her research in several areas of theoretical computer science, especially automata theory and formal languages, and the programming term "Greibach normal form" (GNF) is named after her. While at Harvard, she worked on a project in mathematical linguistics and automatic translation. Automata in the elementary sense are things that are capable of acting

automatically without outside interference. Greibach thus works at the most basic level of computer science, and the impact of her work is not always obvious to the average programmer. Her theoretical research benefits individuals involved in developing fundamental concepts and philosophies that must precede the evolution of subsequent techniques. She works in areas that benefit those people who are involved in transform analysis, transform-centered design, transaction analysis, and various exploratory problem-solving methodologies that are used by designers of systems. The effects of automata theory and formal-language research are normally not felt by programmers until the results finally influence such matters as efficiency of compilation, the relationship of structured design to structured programming techniques, and the use of incrementation.



Computer scientist and mathematician, Sheila Greibach. (Courtesy of UCLA Media Relations)

Her interest in science began in childhood, and her father, the inventor Emil Greibach, held more than 20 patents. After receiving her undergraduate and master's degrees from Radcliffe College, she attended graduate school at Harvard University. She was both a lecturer and an assistant professor at Harvard before joining the faculty at UCLA, where she advanced through the ranks to professor and vice chair of computer science. She served as a consultant to the Rand Corporation and System Development Corporation between 1964 and 1970.

By the early 1980s Greibach was identified as one of the pioneer women in computer sciences. She has published more than 50 technical papers and the book *Theory of Program Structures: Schemes, Semantics, Verification* (1975). She is a member of the American Mathematical Society, Association for Computing Machinery, Institute of Electrical and Electronics Engineers, and Society for Industrial and Applied Mathematics.

Further Resources

University of California, Los Angeles. Faculty website. http://www.cs.ucla.edu/csd/people/faculty_pages/greibach.html.

Greider, Carol W.

b. 1961

Molecular Biologist

Education: B.A., biology, University of California, Santa Barbara, 1983; Ph.D., molecular biology, University of California, Berkeley, 1987

Professional Experience: fellow, Cold Spring Harbor Laboratory, New York, 1988–1990, assistant investigator, 1990–1992, associate investigator, 1992–1994, investigator, 1994–1997; associate professor, molecular biology and genetics, Johns Hopkins University School of Medicine, 1997–1999, professor, 1999–2003, acting director, Department of Molecular Biology and Genetics, 2002–2003, professor, oncology, 2001–, Daniel Nathans Professor and Director, Department of Molecular Biology and Genetics, Johns Hopkins University School of Medicine, 2003–

Carol Greider is a molecular biologist whose work has contributed to cancer research and who, at the age of only 48, shared the 2009 Nobel Prize in Physiology or Medicine with her former advisor **Elizabeth Blackburn** and colleague Jack Szostak. Greider is a professor at Johns Hopkins School of Medicine, but in the early 1980s, she studied with Blackburn at the University of California, Berkeley, where the researchers discovered the enzyme telomerase, the ends of chromosomes that serve an important function in protecting genetic material from the effects of aging and mutations. Their findings have had an enormous impact on the direction and focus of cancer research, aging, and stem-cell research on genetic diseases.

Greider's father was a physics professor at the University of California, Davis. She decided to study at Santa Barbara, where she originally planned on studying marine biology but became intrigued by a laboratory class in biochemistry. She received her undergraduate degree in 1983 and returned north to Berkeley to study molecular biology with cell biologist Elizabeth Blackburn. Blackburn's team had been working on telomeres in yeast and put Greider to work on the project of searching for an unknown enzyme responsible for their growth and structure. In December 1984, Greider discovered the pattern and activity she had been searching for in a telomere-synthesizing enzyme. The experiment was repeated and confirmed the following year, and Greider and Blackburn published the results of their discovery of "telomerase." Greider received her doctorate in 1987 and went on to a postdoctoral fellowship at Cold Spring Harbor Laboratory in Long Island, New York, where she spent the next 10 years as an independent investigator with

funding from the National Institutes of Health. In 1997, she joined the faculty at Johns Hopkins School of Medicine and extended her research to mammalian (including human) cells.

Greider was named a member of the National Academy of Sciences in 2003. She is also an elected fellow of the American Academy of Microbiology, American Association for the Advancement of Science, and American Academy of Arts and Sciences. Among her numerous other honors before receiving the 2009 Nobel Prize, she was awarded a Gertrude Elion Cancer Research Award from the American Association for Cancer Research (1994), Glenn Foundation Award of the American Society for Cell Biology (1995), Cornelius Rhoads Award of the American Association for Cancer

Research (1996), Schering-Plough Scientific Achievement Award of the American Society for Biochemistry and Molecular Biology (1997), Gairdner Foundation Award (1998), Rosenstiel Award in Basic Medical Research (1999), Richard Lounsbery Award of the National Academy of Science (2003), Lila Gruber Cancer Research Award (2006), Albert Lasker Award for Basic Medical Research (2006, shared with future Nobel co-recipients Blackburn and Szostak), and Wiley Prize in Biomedical Sciences (2006, shared with Blackburn).



Molecular biologist Carol Greider was co-recipient of the 2009 Nobel Prize in Physiology or Medicine. (The Nobel Foundation. Photo: Ulla Montan)

Further Resources

Nuzzo, Regina. 2005. "Biography of Carol W. Greider." *Proceedings of the National Academy of Sciences*. 102(23): 8077–8079. (7 June 2005). <http://www.pnas.org/cgi/content/full/102/23/8077>.

Johns Hopkins University. Faculty website. <http://www.hopkinsmedicine.org/pharmacology/research/greider.html>.

"Carol W. Greider: Interview." http://nobelprize.org/nobel_prizes/medicine/laureates/2009/greider-interview.html.

Griffin, Diane Edmund

b. 1940**Microbiologist**

Education: B.A., biology, Augustana College, Illinois, 1962; M.D., Stanford University, 1968, Ph.D., immunology, 1970

Professional Experience: medical intern and resident, Stanford University Hospital, 1968–1970; postdoctoral fellow, virology and infectious diseases, Johns Hopkins University School of Medicine, 1970–1973, assistant professor, medicine and neurology, 1973–1979, associate professor, 1979–1986, professor, medicine and neurology, 1986–, professor and chair, molecular microbiology and immunology, Johns Hopkins Bloomberg School of Public Health, 1994–

Concurrent Positions: investigator, Howard Hughes Medical Institute, 1975–1982; founding director, Johns Hopkins Malaria Research Institute, 2001–2008

Diane Griffin is a microbiologist who is an expert on the effects of infectious viruses on the brain and nervous system. Her primary contribution to public health has been research to support new vaccine development for diseases such as measles. She has conducted research on how the measles virus, while not necessarily life-threatening in itself, can suppress immune responses and infect neurons in the brain and spinal cord, thereby increasing susceptibility to other diseases, such as encephalitis, pneumonia, malaria, and even HIV. She conducted medical field research in Zambia, Africa, and has researched the genetic component of susceptibility to these types of diseases. Her hope is for a measles vaccine that can be introduced to younger infants in both the United States and particularly in developing countries, where measles and HIV pose major widespread public-health concerns.

Griffin showed an early interest in science and chose to attend Augustana College in Rock Island, Illinois, where her father, an oil company geologist, had attended and later taught. She went on to graduate school in a combined Ph.D./M.D. program at Stanford University, and completed her medical internship and one-year residency at Stanford Hospital. The experience helped her decide to focus on research rather than on clinical practice. She followed her husband to Johns Hopkins School of Medicine in Baltimore, Maryland, where she found a position as a postdoctoral fellow in immunology and virology, and began studying the Sindbis virus, an alphavirus that causes encephalitis in mice, and the effect of infection on the central nervous system. She joined the faculty in medicine and neurology in 1973, receiving tenure six years later and then advancing to full professor in 1986. In 1994, she became chair of the Department of Molecular Biology and

Immunology at the Johns Hopkins Bloomberg School of Public Health. In 2001, an anonymous donor contributed funding to establish a malaria research institute at Johns Hopkins, with Griffin as founding director.

Most of Griffin's research has been funded by the National Institutes of Health (NIH), and she has been a member of the NIH Virology Section, as well as the National Multiple Sclerosis Society Research Advisory Committee, U.S.–Japan Viral Diseases Panel, and the Boards of Scientific Counselors for the National Institute of Allergy and Infectious Diseases (NIAID) and National Institute of Neurological Disorders and Stroke (NINDS). She has served on

the editorial boards of major scientific journals in her field, including *Virology*, *Microbial Pathogenesis*, *Intervirology*, *Virus Research*, and *Journal of Virology*.

Griffin was elected to both the National Academy of Sciences and the Institute of Medicine in 2004. She is a fellow of the American Association for the Advancement of Science and the Infectious Diseases Society of America, and a member of the American Association of Immunologists, American Society for Clinical Investigation, Interurban Clinical Club (president, 1993), American Society for Virology (president, 1999–2000), and American Society of Microbiology (president, 2006–2007). She received the International Society for NeuroVirology Pioneer in NeuroVirology Award (2009) and has been inducted into Maryland Women's Hall of Fame (2009).

Further Resources

Johns Hopkins University. Faculty website. <http://faculty.jhsph.edu/?F=Diane&L=Griffin>.



Microbiologist Diane Edmund Griffin.
(Courtesy of Johns Hopkins)

Gross, Carol A. (Polinsky)

b. 1941

Bacteriologist

Education: B.S., Cornell University, 1962; M.S., Brooklyn College, 1965; Ph.D., bacteriology, University of Oregon, 1968

Professional Experience: postdoctoral fellow, University of Oregon, 1969–1973; project associate, University of Wisconsin, 1973–1976; assistant to associate scientist, McArdle Laboratory for Cancer Research, University of Wisconsin, 1976–1981, assistant professor to professor, bacteriology, 1981–1992; professor, stomatology and microbiology, University of California, San Francisco, 1993–

Concurrent Positions: visiting professor, Department of Chemistry, Nanjing University, China, 1985

Carol Gross is a noted bacteriologist who studies the production of cell proteins in response to heat. When cells are subjected to high temperatures, nearly all begin to produce large quantities of certain proteins, and these are characterized by their ability to grow and thrive at what is ordinarily a lethal temperature. She is looking at the function that these proteins serve and the precise nature of how they operate. Another project is the structure and function of RNA polymerase, an enzyme that binds compounds in and transcribes DNA, thus regulating how DNA interacts with the cell. As a project associate at the University of Wisconsin studying RNA, she developed an interest in cancer research and moved to the university's McArdle Laboratory for Cancer Research. She later taught in the Department of Bacteriology before moving to the University of California, San Francisco in 1993. Her doctoral thesis was on the subject of *E. coli* bacteria, and her lab continues to study and publish on the topic.

Gross was elected to membership in the National Academy of Sciences in 1992 and has received numerous honors. In 1985, she became a member of the scientific advisory committee of the Damon Runyon–Walter Winchell Cancer Research Fund, a prestigious funder of research. She was named editor of the *Journal of Bacteriology* in 1990 and became a member of the editorial board of *Genes and Development* the same year. She is a member of the American Academy of Arts and Sciences.

Further Resources

University of California, San Francisco. Faculty website. <http://www.ucsf.edu/gross/>.

Gross, Elizabeth Louise

1940–2007

Biochemist

Education: B.A., biophysics, University of California, Los Angeles, 1961; Ph.D., biophysics, University of California, Berkeley, 1967

Professional Experience: research associate, C. F. Kettering Research Laboratory, 1967–1968; assistant professor to professor, biochemistry, Ohio State University, 1968–2006

Elizabeth Gross is credited with inventing photovoltaic cells that use living organisms—“living batteries,” as they are popularly called. Her research interests included biophysical and biochemical studies of chloroplast membrane proteins including plastocyanin and the pigment–protein complexes, biological solar energy, and chloroplast solar batteries. The photovoltaic effect is a phenomenon in which the incidence of light or other electromagnetic radiation upon the junction of two materials induces the generation of electromotive force. In simple terms, a photovoltaic cell converts sunlight directly into electricity. Gross produced 2,000 microvolts of power at 4% to 5% efficiencies by devising a way to use a cheap carbon electrode instead of platinum in the chloroplast solar battery. A chloroplast is a plastid containing chlorophyll, and a plastid is a small, double-membrane organelle of plant cells and certain protists occurring in several forms as the chloroplast and containing ribosomes, prokaryotic DNA, and often pigment. In other words, she sought a way to harness the plant world’s use of photosynthesis as a “green solar battery.” In the 1980s, there was great interest in photovoltaic cells by major companies, and in addition to using them in space vehicles and satellites, there was scientific and popular interest in reducing pollution and preserving fossil-fuel resources through substituting solar-powered cars, solar heat, and other uses for solar energy.

Gross was a professor of biochemistry at Ohio State University for nearly 40 years and served for many years as director of the program in biophysics. Her research was published widely in scientific journals. In 1989, she was honored with an Outstanding Women in Science Award from the Association for Women in Science in Central Ohio. She was a member of the Biophysical Society, American Society of Biological Chemists, American Society of Plant Physiologists, American Chemical Society, and International Solar Energy Society.

Guthrie, Mary Jane

1895 1975

Zoologist, Cytologist

Education: A.B., University of Missouri, 1916, A.M., 1918; Ph.D., Bryn Mawr College, 1922

Professional Experience: demonstrator, biology, Bryn Mawr College, 1918–1920, instructor, 1920–1921; assistant professor, zoology, University of Missouri, 1922–1926, associate professor, 1927–1937, professor, 1937–1950; professor, biology, Wayne State University, 1950–1960; research associate, Detroit Institute for Cancer Research, 1951–1960

Mary Guthrie was a zoologist who specialized in the cytology (or cell biology) of the female reproductive system and endocrine glands. After completing undergraduate and master's degrees at the University of Missouri, near her hometown, she went to Bryn Mawr to study with zoologist **Florence Peebles**. Guthrie taught at Bryn Mawr while working on her doctorate, then returned to Missouri, where she was appointed assistant professor; among her colleagues at Missouri were plant geneticist **Barbara McClintock**, with whom Guthrie occasionally co-taught courses in genetics and cytology. Guthrie rose through the ranks to full professor before leaving the institution in 1950 for a position at Wayne State University. During this time, she was also an affiliated research associate at the Detroit Institute for Cancer Research, but retired from both positions in 1960. Her research at the institute focused on ovarian cancer. She created *in vitro* ovaries to understand how tumors began. Although she was a noted scientist, she sometimes had difficulty obtaining funding. An official at the Rockefeller Foundation once explained to her that, although women were not officially excluded from their fellowship program, as a woman scientist she would need to submit additional materials to support her grant application. She co-authored three textbooks with other zoologists: *Textbook of General Zoology* (1938, with Winterton Conway Curtis), *General Zoology* (1957, with John Anderson) and *Laboratory Directions in General Zoology* (1958, also with Anderson).

Guthrie was professionally active as a member of the American Association for the Advancement of Science, American Society of Naturalists, American Society of Zoologists, American Association of Anatomists, Genetics Society, American Society of Mammalogists, and Tissue Culture Association. She was also a member of the editorial board of the *Journal of Morphology* (1944–1947).

Guttman, Helene Augusta (Nathan)

b. 1930

Microbiologist, Biochemist

Education: B.A., Brooklyn College, 1951; M.A., Harvard University, 1955; M.A., Columbia University, 1958; Ph.D., bacteriology, Rutgers University, 1960

Professional Experience: research technician, immunology, Public Health Research Institute, New York City, 1951–1952; assistant microbiologist, Haskins Labs, 1952–1956, research associate, 1956–1959, staff member, 1959–1964; research associate, Goucher College, 1960–1962; assistant to associate professor, biochemistry and cell physiology, University College and Graduate School of Arts and Sciences, New York University, 1962–1967; associate professor to professor, biological sciences, University of Illinois, Chicago Circle, 1967–1975, professor, microbiology, College of Medicine, 1969–1975, faculty associate, urban systems laboratory, College of Engineering, 1974–1975, associate director of research, 1975; expert, Office of the Director, Heart, Lung, and Blood Institute, 1975–1977, research resources coordinator, Office of Program Planning and Evaluation, 1977–1979; deputy director, science advisory board, U.S. Environmental Protection Agency, 1979–1980; program coordinator, Science Education Coordinating Office, Science and Education Directorate, U.S. Department of Agriculture (USDA), 1980–1983, associate director, Beltsville Human Nutrition Research Center, 1983–1989, animal care coordinator, National Program Staff, Agricultural Research Service, 1989–; founder and counselor, Sound Balance

Helene Guttman is known for her work in nutritional biochemistry, microbiology, and the mind–body connection in healing. Her research interests have included behavioral biochemistry; control of inducible syntheses; isolation and purification of bioactive natural products; nutrition biochemistry; and drug mode of action at the cellular level. After receiving her undergraduate degree from Brooklyn College, she worked for the Public Health Research Institute and Haskins Labs before receiving one master's degree from Harvard and a second from Columbia. She received her doctorate from Rutgers in 1960 and was a research associate at Goucher College before joining the faculty of New York University. She moved to the University of Illinois, Chicago Circle, where she also held a joint professorship in the College of Medicine.

Guttman left academia in 1975 to work at the Heart, Lung, and Blood Institute of the National Institutes of Health, and then moved to the U.S. Environmental Protection Agency. She joined the USDA in the Science and Education Directorate, was appointed associate director of the Beltsville Human Nutrition Research Center, and then moved to the position of animal care coordinator of the Agricultural Research Service. Her office was in charge of issuing government bulletins and papers about animal care, a high-profile topic due to the increased activities of animal-rights groups concerned about animal experimentation in research, humane livestock practices, and the health and environmental costs of vegetarianism. During Guttman's tenure, some animal-rights groups began using aggressive tactics such as invading laboratories and destroying equipment. She is the author

of *Experiments in Cellular Biodynamics* (1972) and editor of *Science and Animals: Addressing Contemporary Issues* (1989).

Guttman left the USDA to begin her own counseling service, Sound Balance, focused on combining physical, psychological, and spiritual approaches to healing. She has been active on issues concerning women and women scientists such as chairing the Professional Opportunities for Women Commission of the American Institute of Chemists (1974–1978) and serving on the advisory board of *Creative Women* (starting in 1970). She has also served as a member of the Status of Women Microbiologists Commission (1980–1985) and was a member of the education committee of the Illinois Commission on the Status of Women (1974–1975). She is a fellow of the American Institute of Chemists, American Academy of Microbiology, New York Academy of Sciences, and American Association for the Advancement of Science. She is a member of the American Society for Microbiology, American Society of Biological Chemists, American Society for Cell Biology, and American Society of Clinical Nutrition.

Further Resources

Sound Balance. <http://www.soundbalance.net/>.

H

Haas, Mary Rosamond

1910–1996

Linguist, Anthropologist

Education: B.A., Earlham College, 1930; Ph.D., linguistics, Yale University, 1935

Professional Experience: researcher, Yale University, 1936–1938; committee member, American native languages, American Council of Learned Societies, 1938–1941, committee member and research fellow, modern Oriental languages, 1941–1946; lecturer, Siamese, University of California, Berkeley, 1943–1947, assistant professor to professor, languages and linguistics, 1947–1977

Mary Haas was a leader in anthropological linguistics due to her work on Native American languages as well as her pioneering research on the relationship of ethnology and sociology to language. The latter included men's and women's speech, word taboos, word games, kinship vocabulary, and language contact. In the 1940s, during World War II, she responded to the national need for expertise on languages of the Far East and published several grammars and dictionaries of Thai and Burmese (previously called Siamese). She joined the faculty at the University of California, Berkeley in 1947, and returned to her interests in Native American linguistics. She was instrumental in founding the Survey of California Indian Languages at Berkeley in 1953, a program that trains graduate student field researchers and maintains archives on native languages. She also founded the Language Lab at Berkeley (now the Berkeley Linguistic Center), which provides resources for foreign-language students as well as housing a sound archive of recordings of Native American languages. Without Haas's efforts, many languages and dialects might have been lost entirely to history.

Haas's first fieldwork was with the Nitinat tribe of British Columbia. For her doctoral research, she went to Louisiana to work with the lone surviving speaker of Tunica. She later published a grammar, a dictionary, and a text collection of the Tunica language. Her research launched her career as the principal authority on the languages of the native southeastern United States, including Natchez and Muskogean families, and she later studied many other North American linguistic families. Her work provided solid corroboration of studies conducted by

anthropologists, archaeologists, and ethnologists. After her official retirement in 1977, she was sought as a guest lecturer and visiting professor at universities worldwide. In addition to her books on the Thai language, Haas published *The Prehistory of Languages* (1969), still read by graduate students of historical linguistics, and *Language, Culture, and History* (1978), as well as numerous scientific papers.

Haas was elected to membership in the National Academy of Sciences in 1978. She received numerous honorary degrees and awards, including the Berkeley Citation of the University of California, Berkeley (1977) and the Wilbur Cross Medal of Yale University (1977). In 1986, she was honored at the Haas Festival Conference on Native American Linguistics held at the University of California, Santa Cruz. *In Honor of Mary Haas* (1988) is a collection of papers presented by colleagues and former students at the conference. Her bequest to Berkeley helped establish the Mary R. Haas Memorial Fund to support linguistics students. She was a member of the Linguistics Society of America (president, 1963), American Anthropological Association, American Oriental Society, and American Academy of Arts and Sciences.

Further Resources

"Mary Rosamond Haas, Linguistics: Berkeley." <http://content.cdlib.org/xtf/view?docId=hb0z09n6nn&doc.view=frames&chunk.id=div00028&toc.depth=1&toc.id>.

Hahn, Dorothy Anna

1876–1950

Chemist

Education: A.B., chemistry and biology, Bryn Mawr College, 1899; University of Leipzig, 1906–1907; Ph.D., Yale University, 1916

Professional Experience: professor, chemistry, Pennsylvania College for Women (Chatham College), 1899–1906; professor, biology, Kindergarten College, Pittsburgh, 1904–1906; instructor, Mount Holyoke College, 1908–1914, associate professor, 1914–1918, professor, 1918–1941

Dorothy Hahn was recognized for her research on the synthesis of hydantoins, such as vitamin B. The research required the application of both skillful organic chemical technique and the newly developed methods of ultraviolet spectrophotometry. She became actively interested in industrial chemistry, specifically coal-tar products, an interest that not only contributed to her awareness of important

new developments but made it possible for Mount Holyoke to obtain needed facilities and scholarships. During her long tenure at Mount Holyoke, she (along with colleagues such as physical chemist **Emma Perry Carr**) helped establish a first-rate chemistry department by encouraging undergraduate research and launching their female students into graduate study in the sciences.

Hahn obtained her education over a long period and in a number of laboratories, training at Bryn Mawr, Leipzig, and Yale at intervals over 17 years. As with many female scientists of the early twentieth century, she found it difficult to find a university position. She began her career teaching at colleges in Pennsylvania before spending a year abroad in Germany, studying organic chemistry at the University of Leipzig. She returned to further study at her alma mater, Bryn Mawr, and began teaching at Mount Holyoke before completing her doctorate at Yale in 1916. Soon after receiving the Ph.D., she was promoted to full professor at Mount Holyoke, where she remained until her retirement in 1941.

In addition to publishing numerous papers in scientific journals, especially for the *Journal of the American Chemical Society*, she also collaborated on several books, including *A Dictionary of Chemical Solubilities, Inorganic* (1921, with Arthur Comey), and a translation and enlargement of Ferdinand Henrich's *Theories of Organic Chemistry* (1922, with Treat B. Johnson). She was a member of the American Chemical Society and the Deutsche Chemische Gesellschaft.

Further Resources

Shmurak, Carole B. and Bonnie S. Handler. 1992. "‘Castle of Science’: Mount Holyoke College and the Preparation of Women in Chemistry, 1837–1941." *History of Education Quarterly*. 32(3): 315–342.

Hamerstrom, Frances (Flint)

1907–1998

Wildlife Biologist, Ornithologist

Education: student, Smith College, 1926–1928; B.S., biology, Iowa State University, 1935; M.S., wildlife biology, University of Wisconsin, 1940

Professional Experience: staff, Edwin S. George Reserve, Pinckney, Michigan, 1940–1943 and 1946–1949; game biologist, Wisconsin Department of Natural Resources, 1949–1972; director, Raptor Research Foundation, 1976–1979; adjunct professor and research associate, University of Wisconsin, Stevens Point, 1982–1998

Frances Hamerstrom was an internationally known wildlife biologist, one of the few women to pursue this profession, whose research focused on ecology and behavior of raptors and hunting ethics and habits. Even before completing her undergraduate degree, she studied birds at the Game Conservation Institute in New Jersey (1931–1932). She attended Smith College before transferring to Iowa State University, where she studied pheasants, quail, and birds of prey. She went on to graduate study at the University of Wisconsin, where she studied the habitat of the greater prairie chicken with famed naturalist Aldo Leopold. She later received an honorary doctorate from Carroll College in Wisconsin in 1961. After receiving her master's degree, she worked as a game biologist for the Wisconsin Department of Natural Resources for more than 20 years. She served as director of the Raptor Research Foundation for three years and then joined the faculty of the University of Wisconsin, Stevens Point as an adjunct professor beginning in 1982. Her work supported conservation and species-preservation efforts.

In addition to her own original research and publications, Hamerstrom also used her language skills to review foreign-language books on ornithology for an American audience. Her 1986 book *Harrier, Hawk of the Marshes* was the culmination of several decades worth of observation and research. In addition to her scientific papers on the golden eagle and the prairie chicken, she wrote magazine articles on nature study and several autobiographical works on her life and work, such as *Strictly for the Chickens* (1980), *Birding with a Purpose* (1984), *Is She Coming Too?: Memoirs of a Lady Hunter* (1989), and *My Double Life: Memoirs of a Naturalist* (1994). She also published two children's books: *Walk When the Moon Is Full* (1975) and *The Adventure of the Stone Man* (1977).

Her husband, Frederick Nathan Hamerstrom, Jr., was also a naturalist and ornithologist, and the two collaborated on publications and shared awards from the Wildlife Society (1940) for their publication *The Great Horned Owl and Its Prey in the North-Central States*, and the National Wildlife Federation Conservationist of the Year Award (1970). Frances Hamerstrom later received another Wildlife Society award (1957) for *A Guide to Prairie Chicken Management*. She also received the Joseelyn Van Tyne Award of the American Ornithologists Union (1960), Chapman Award of the American Museum of Natural History (1964), Silver Passenger Pigeon Award from the Wisconsin Society for Ornithology (1966), Distinguished Service Award from the National Wildlife Federation (1970), Silver Acorn Award from Citizens Natural Resources Association (1972), a research award from the Wisconsin Department of Natural Resources (1973), and the Golden Passenger Pigeon Award (1973). She was elected a fellow of the American Ornithologists' Union and was a member of the Wilson Ornithological Society, Wisconsin Society for Ornithology (president, 1960–1961), Wisconsin Peregrine Society, American Society of Mammalogists, Citizens Natural Resources Association, Raptor Research

Foundation, North American Falconers Association, and Wisconsin Academy of Science, Arts and Letters. She was also a member of international organizations such as the British Ornithologists Union, British Falconry Club, Deutsche Falkenorden, and Deutsche Ornithologen Gesellschaft.

Further Resources

Bildstein, Keith L. 1999. "In Memoriam: Frances Hamerstrom, 1907–1998." *The Auk: Journal of the American Ornithologists' Union*. 116(4): 1122–1124. <http://elibrary.unm.edu/sora/Auk/v116n04/p1122-p1124.pdf>.

Hamilton, Alice

1869–1970

Industrial Toxicologist

Education: M.D., University of Michigan, 1893, A.M., 1910

Professional Experience: professor, pathology, Woman's Medical College of Chicago, 1897–1902; assistant pathologist, McCormick Institute for Infectious Diseases, 1902–1909; special investigator, Occupational Poisons, U.S. Bureau of Labor Statistics, 1911–1921; assistant professor, Department of Industrial Medicine, Harvard Medical School, 1919–1935

Alice Hamilton was a pioneer in the science of industrial toxicology and an authority on hazardous industries and occupational diseases. She worked in both industry and government positions, including as a consultant to the Bureau of Labor Statistics. She was the first female faculty member at Harvard Medical School, and when she joined the faculty as an assistant professor of industrial medicine in 1919, she insisted on a half-time appointment so she could continue to pursue her research. She retired from Harvard in 1935 but was a crusader for industrial safety and health legislation well into her eighties, serving for a time as a medical consultant to the U.S. Division of Labor Standards.

Hamilton obtained her M.D. at the University of Michigan in 1893 and went to pursue postgraduate studies and complete internships at several other institutions. After interning in Minneapolis and Boston, she decided to specialize in bacteriology and pathology. She went to Germany for further training at the University of Leipzig, University of Munich, and University of Frankfurt in 1896, and returned for postgraduate studies and research at Johns Hopkins University. She received her first appointment as professor of pathology at the Woman's Medical College of Chicago in 1897. When this school closed in 1902, she moved to the newly

opened McCormick Institute for Infectious Diseases. She studied briefly at the Pasteur Institute in Paris to prepare for her work at McCormick. Through her contacts with people at the Hull House settlement founded by social reformers in Chicago, she found that many immigrant workers had been permanently debilitated by the fumes they inhaled on the job in steel mills, factories, and foundries. This was the foundation for her campaign to establish the occupational disease commission in Illinois in 1910, the first of its kind in the United States. She fought for workers' rights to healthcare and compensation due to industrial accidents and was also involved in a campaign against the hazards of leaded gasoline for automobiles.

Hamilton's books, *Industrial Poisons in the United States* (1925) and *Industrial Toxicology* (1934), are considered classic works that eventually led to the passage of workers' compensation laws. She also published an autobiography, *Exploring the Dangerous Trades* (1943; reprinted in 1985). She was a member of the American Association for the Advancement of Science, the American Medical Association, and the American Public Health Association, and, between 1924 and 1930, the only female member of the League of Nations Health Committee. In 1947, she received the Lasker Award. Her contributions to public health have been acknowledged posthumously with the naming of the Alice Hamilton Laboratory at the National Institute for Occupational Safety and Health, an annual Alice Hamilton Award by the Institute, and a U.S. Postal Service commemorative stamp.

Further Resources

Sicherman, Barbara, ed. 2003. *Alice Hamilton: A Life in Letters*. 2nd ed. Cambridge, MA: Harvard University Press.

Hamilton, Margaret

b. 1936

Computer Scientist, Systems Engineer

Education: student, University of Michigan, 1955; B.A., mathematics, Earlham College, 1958

Professional Experience: school teacher, 1959; programmer, Massachusetts Institute of Technology (MIT), 1960; Philco-Ford Sage Project and Air Force Cambridge Research Laboratory, 1961–1963; programmer, Draper Laboratory, MIT, 1963–1965, supervisor and director, Software Engineering Division, 1965–1977; founder and CEO, Higher Order, Inc., 1978–; founder and CEO, Hamilton Technologies, Inc. (HTI), 1986–

Margaret Hamilton is known as one of the chief systems analysts on the Apollo spacecraft project. She was assistant director of software engineering at Draper Laboratory of MIT when the onboard computers and guidance instruments for all the manned moon missions were designed. She said that as one of the first programmers hired, she became acquainted with all phases of the project and assisted other personnel with problem solving. At the peak of the Apollo project, she supervised about 100 engineers, mathematicians, programmers, and technical writers. She oversaw two separate subgroups—one for the onboard computer in the command module, the other for the computer in the lunar excursion module (LEM). The programs her group devised were very complex. Before each Apollo mission, she had to anticipate all possible eventualities and program the two computers to be ready for them. The computers had to process and respond to input from Mission Control, spacecraft instruments such as radar, and the astronauts. One of Hamilton's programs established the order in which the computer must do the various jobs it was asked to do at once. The National Aeronautics and Space Administration (NASA) eventually took over the Apollo project, and MIT's role was greatly reduced. Hamilton's other projects at MIT included overseeing a biomedical bedside computer, a new computer language and compiler, security systems, control systems for aircraft, a data-management system for the Department of Transportation, air traffic control instrumentation, the space shuttle, the unmanned Mars landing, and Skylab.

After receiving her undergraduate degree in mathematics, she married and taught math and French in public school while her husband completed college. After the couple moved to Boston, Hamilton planned to enroll in graduate school, but obtained a job at MIT as a programmer for a professor doing meteorological prediction and statistical long-range weather forecasting. She then worked for Philco-Ford's Sage Project, a radar defense system that tracked unknown aircraft. At the same time, she did general programming for satellite tracking at the Air Force Cambridge Research Laboratory. She returned to MIT in 1963 to do programming for another meteorology professor, which led to the opportunity to work on the Apollo project. In 1977, she founded a computer company to develop industrial systems, Higher Order, Inc., with a former colleague. The software they developed was designed to catch mistakes, such as a missing step in a manufacturing process, before they happen, a systems design model known as Development Before the Fact (DBTF), which became the specialty for programs and software developed in her next company, Hamilton Technologies, Inc., founded in 1986.

Hamilton received the Augusta Lovelace Award from the Association for Women in Computing (1986) and the NASA Exceptional Space Act Award (2003) for her innovations. This honor included NASA's largest cash award ever given to an individual.

Further Resources

National Aeronautics and Space Administration Office of Logic Design. "About Margaret Hamilton." http://klabs.org/home_page/hamilton.htm.

Hamilton Technologies, Inc. <http://www.htius.com/>.

Hammel, Heidi

b. 1960

Astronomer

Education: B.S., earth and planetary science, Massachusetts Institute of Technology, 1982; Ph.D., physics and astronomy, University of Hawaii, 1988

Professional Experience: team member, National Aeronautics and Space Administration (NASA) *Voyager* Imaging Science Team, Jet Propulsion Laboratory, Pasadena, California, 1989; principal research scientist, earth, atmospheric and planetary sciences, Massachusetts Institute of Technology (MIT), 1990–1998; senior research scientist, Space Science Institute, Boulder, Colorado, 1999–, co-director, Research Branch, 2003–

Concurrent Positions: team leader, NASA Hubble Space Visible/New-UV Imaging Team, 1994

Heidi Hammel was part of the scientific team that oversaw the *Voyager* encounter with Neptune in 1989. That work, in turn, resulted in the assignment to be the team leader for the Comet Shoemaker–Levy 9 Collision with Jupiter in 1994. Hammel worked with the Hubble Space Telescope Team to study the comet's impact on Jupiter's atmosphere. During the television coverage of the Shoemaker–Levy 9 event, she showed the ability to explain the phenomena enthusiastically in language the general public could understand. Her facility with the media led to her 1997 appearance on a Discovery Channel television documentary on the Hubble Space Telescope. In 1996, the International Astronomical Union named asteroid 3530 "Hammel" in her honor. In 1999, she joined the Space Science Institute in Boulder, Colorado, where she continues to research Neptune and Uranus. She is also involved as a research scientist for the James Webb Space Telescope, which is scheduled to launch by 2013.

As a child, Hammel received a toy telescope and had her first experiences of sky watching. She also regularly visited the planetarium in Harrisburg, Pennsylvania, where the family lived. She excelled in math, and a teacher encouraged her to apply to MIT, where she became interested in a career in astronomy and received her

undergraduate degree in earth and planetary science. She enrolled in graduate school at the University of Hawaii at Manoa because that school had the largest and best telescopes for the subject she was studying. Her dissertation was on the clouds and structure of Neptune. She is the subject of a 2006 book by Fred Bortz, *Beyond Jupiter: The Story of Planetary Astronomer Heidi Hammel*, part of a “Women’s Adventures in Science” juvenile series for National Academies Press. She is currently involved in a collaboration with author Noreen Grice on a book project entitled “Touch the Solar System,” which will combine Braille and textured images to bring space telescope photos to blind readers.



Astronomer Heidi Hammel. (AP/Wide World Photos)

Hammel has received numerous awards and honors, including the NASA Group Achievement Award for *Voyager* Science Investigation (1990), the Vladimir Karapetoff Award from MIT in recognition of her contributions to science and education (1994), and the Klumpke-Roberts Award of the Astronomical Society of the Pacific (1995), named for Dorothea Klumpke-Roberts, an American woman who worked for the Paris Observatory between 1887 and 1901 and was renowned for her work in charting and cataloging stars. Hammel has also received the 1996 Harold C. Urey Prize of the American Astronomical Society (AAS) (1996), the Public Understanding of Science Award of the Exploratorium (1998), and the Carl Sagan Medal of the AAS (2002). In 2002, she was named one of the “50 Most Important Women in Science” by *Discover* magazine. She is a fellow of the American Association for the Advancement of Science and a member of the American Astronomical Society and of the Board of Directors of the Planetary Society (2005–).

Further Resources

Planetary Society. “Heidi Hammel.” http://www.planetary.org/about/heidi_hammel.html.

Space Science Institute. “Heidi B. Hammel: Senior Research Scientist.” http://www.space-science.org/about_ssi/staff/hammel.html.

Harris, Jean Louise

1931–2001

Physician

Education: B.S., Virginia Union University, 1951; M.D., Medical College of Virginia, 1955

Professional Experience: intern, Medical College of Virginia, 1955–1956, resident, internal medicine, 1956–1957, fellow, 1957–1958; fellow, Strong Memorial Hospital, School of Medicine, University of Rochester, 1958–1960; instructor, medicine, College of Medicine, Howard University, 1960–1968, assistant professor, community health practice, 1969–1972; professor, Virginia Commonwealth University, 1973–1979, clinical professor, family practice, 1978; secretary of human resources, Commonwealth of Virginia, 1978–1982; president and chief executive officer, Ramsey Foundation, 1988–1992; senior associate director, medical affairs, University of Minnesota Hospital and Clinic, 1992–1998; mayor, Eden Prairie, Minnesota, 1999–2001

Concurrent Positions: research associate, Walter Reed Army Institute of Research, 1960–1963; private practice, internal medicine and allergies, 1964–1971; chief, Bureau of Resources Development, District of Columbia Department of Health, 1967–1969; director, Center for Community Health Consultants, Department of Health, Education, and Welfare, 1969–1977; assistant clinical professor, community medicine, Charles R. Drew Postgraduate Medical School, Los Angeles, 1970–1972; executive director, National Medical Association Foundation, 1970–1973; vice president of state marketing programs, Control Data Corporation, 1982–1984, vice president of state government affairs, 1984–1986, vice president of business development, 1986–1988

Jean L. Harris was a specialist in internal medicine and an allergist who held high-level positions in academia, state government, federal government, private industry, and professional associations. She was the first African American to be admitted to the Medical College of Virginia (now part of Virginia Commonwealth University), where she also became the first full-time black faculty member. She went on to become the first woman and first African American to be named to the cabinet of a Virginia governor when she was named Secretary of Human Resources in 1978. In the last years of her life, she served as mayor of her hometown in Eden Prairie, Minnesota.

Harris had numerous appointments in the federal government, such as research associate at the Walter Reed Army Institute of Research and director of the Center for Community Health Consultants of the Department of Health, Education, and

Welfare. She was executive director of the National Medical Association Foundation as well as working in private practice as a physician of internal medicine and allergist. She also had high-level appointments to committees, such as being a member of the recombinant DNA advisory committee of the National Institutes of Health (1979–1982), vice chairman of the National Commission on Alcoholism and Alcohol-Related Diseases (1980–1981), member of the President’s Private Sector Initiative Task Force (1981–1982), member of the Defense Advisory Commission on Women in the Service (1985–1988), and member of the Advisory Council on Sickle Cell of the National Heart, Lung, and Blood Institute (1975–1979). In 1993, Virginia Commonwealth University established the Jean L. Harris Scholars Program for medical school students, and in 2002, the state of Virginia passed a resolution to honor her career and contributions.

Harris was a fellow of the Royal Society of Health and a member of the Institute of Medicine of the National Academy of Sciences, the American Academy of Medical Administrators, and the American Public Health Association.

Further Resources

Virginia Senate Joint Resolution No. 233. (2002). <http://leg1.state.va.us/cgi-bin/legp524.exe?021+ful+SJ233ER>.

Harris, Mary (Styles)

b. 1949

Geneticist, Epidemiologist

Education: B.A., Lincoln University, 1971; Ph.D., genetics, Cornell University, 1975

Professional Experience: fellow, National Cancer Institute, New Jersey College of Medicine and Dentistry (now Robert Wood Johnson Medical School), 1975–1977; instructor, genetics, School of Medicine, Morehouse College, 1978–1986; president and consultant, Harris & Associates Ltd., 1986–; CEO, BioTechnical Communications, 1987–

Concurrent Positions: research associate, tumor virology, Rutgers Medical School, 1975–1977; executive director, Sickle Cell Foundation of Georgia, Inc., 1977–1979; National Science Foundation Residency, 1979–1980; scientist in residence, television station WGTV, University of Georgia, 1979–1980; assistant director, science and public policy, Atlanta University, 1980–1981; instructor, Human Genetics, Emory University, 1982; director, Genetic Service, Georgia Department of Human Resources, 1982–1985

Mary Harris is a geneticist who has made a professional commitment to connecting research in the biological sciences to healthcare literacy among minorities. Her website, JourneyToWellness.com, is an online health magazine and portal for her weekly call-in radio program on African American health issues and healthcare literacy. Early in her career, she focused on genetic testing of children in her capacity as executive director of the Sickle Cell Foundation of Georgia and state director of genetics service in Georgia. Sickle-cell anemia, which occurs primarily among Africans or persons of African descent, is a chronic hereditary blood disease that can be identified through genetic testing. In 1979, she employed an unusual technique for educating the public by using a National Science Foundation grant to work with broadcasters to produce a series of television documentary programs on the relationship between science and medicine.

Harris was encouraged to enter the medical field by her physician father. When she entered high school in 1963, she was among the first blacks to attend an integrated school. She volunteered at a local black-owned medical laboratory nights and weekends; in exchange, the staff showed her how to use the equipment and how to do routine biological tests. She was one of the first women to enter Lincoln University in Pennsylvania, and colleagues of her father arranged, through a minority recruitment program, to reserve a place for her at the University of Miami Medical School. By then, however, she had decided to concentrate on research rather than become a physician and she accepted instead a Ford Foundation fellowship to study molecular genetics. She received her Ph.D. from Cornell University in 1975.

In 1986, Harris moved to California, where she founded her own firm, Harris & Associates, to consult for companies that were engaged in genetic engineering. She received a grant from the National Cancer Institute to produce a new series of television programs on the particular health problems of African Americans, and created another company, BioTechnical Communications, to produce audio-visual educational materials on a broad range of healthcare issues encountered by women and minorities. She produced an award-winning documentary about African American women and breast cancer, *To My Sisters . . . A Gift for Life*, which has been widely distributed. Harris has produced numerous radio shows with funding from the National Institutes of Health, including those focused on issues of the social disparities of diseases such as cancer, obesity, and HIV/AIDS. In addition to her radio and television work, Harris has consulted for a variety of educational, research, and government organizations, and has published widely in health and science journals.

Harris has received numerous awards for her work in the media and public health, and her work has been funded and supported by numerous medical schools as well as the National Cancer Institute, National Medical Association, American

Cancer Society, American Heart Association, Johnson & Johnson Family of Companies, National Rural Health Association, American Diabetes Association, and Arthritis Foundation.

Further Resources

Journey to Wellness. <http://www.journeytowellness.com/>.

Harrison, Anna Jane

1912–1998

Chemist

Education: A.B., University of Missouri, 1933, M.A., 1937, Ph.D., physical chemistry, 1940

Professional Experience: instructor, chemistry, Newcomb College, Tulane University, 1940–1942, assistant professor, 1942–1945; assistant to associate professor, Mount Holyoke College, 1945–1950, professor, 1950–1979

Anna Harrison was a distinguished organic chemist who was elected the first woman president of the American Chemical Society in 1978. Her area of research was vacuum ultraviolet spectroscopy. She received her doctorate in physical chemistry from the University of Missouri and taught several years at Tulane before accepting a faculty position at Mount Holyoke, where she rose through the ranks to become full professor by 1950. She also worked briefly during World War II on a project on toxic smoke for the National Defense Council. Although chemistry was an increasingly popular area of study for women in the first half of the twentieth century, many female chemists were employed in industry or in home economics departments, and few held full



Chemist Anna Harrison was the first woman president of the American Chemical Society in 1978. (Bettmann/Corbis)

professorships or department head positions as Harrison eventually did. After her retirement, she co-authored (with Mount Holyoke colleague Edwin Weaver) a textbook for nonmajors entitled, *Chemistry: A Search to Understand* (1989).

Harrison was active in professional organizations and committees. She served on committees of the National Research Council, was a member of the National Science Board (1972–1978), and was a fellow of the American Association for the Advancement of Science (president, 1983–1984). She received the Frank Forest Award of the American Ceramic Society (1949), the Citation of Merit of the University of Missouri College of Arts and Sciences (1960), the College Chemistry Teaching Award of the Manufacturing Chemists Association (1969), the American Chemical Society's James Flack Norris Award of Outstanding Achievement in the Teaching of Chemistry (1977), and the Chemical Education Award of the American Chemical Society (1982).

Further Resources

Mount Holyoke. "Anna Jane Harrison, Chemical Education Leader and First Woman President of the American Chemical Society, Dies at 85." <http://www.mtholyoke.edu/offices/comm/press/releases/annaharrison.shtml>.

Harrison, Faye Venetia

b. 1951

Anthropologist

Education: B.A., Brown University, 1974; M.A., Stanford University, 1977, Ph.D., anthropology, 1982

Professional Experience: assistant professor, anthropology, University of Louisville, 1983–1989; associate professor, anthropology, University of Tennessee, Knoxville, 1989–1997; professor, anthropology and graduate director, women's studies, University of South Carolina, Columbia, 1997–1999; professor, anthropology, University of Tennessee, Knoxville, 1999–2004; professor, African American studies and anthropology, University of Florida, Gainesville, 2004–2005, director, African American studies, 2007–

Concurrent Positions: fellow, Social Science Research Institute, University of Tennessee, Knoxville, 1991–1992; chair, Commission on Anthropology of Women, International Union of Anthropologists and Ethnological Sciences, 1993–; adjunct associate professor, anthropology, State University of New York,

Binghamton, 1996–1998; adjunct professor, Graduate College, Union Institute and University, 2002–

Faye Harrison is an anthropologist whose research focuses on how people of African descent both shape and are shaped by their cultural environments. She has studied people from the Cape Verde Islands off the coast of Africa who have immigrated to the United States, natives of the West Indies who immigrated to London, West Indian families who live in the West Indies, and the oral histories of her own ancestors who lived in North Carolina and Virginia. Harrison became interested in different cultures as a child when she discovered a closetful of old *National Geographic* magazines. In high school, she studied Spanish, Portuguese, and French, and received a scholarship to travel to Puerto Rico with a group of other language students.

She received a full university scholarship to study anthropology at Brown and completed an independent research project on the attitudes and opinions of American descendents of people from the Cape Verde Islands who had retained their original language of Portuguese. She later studied West Indians in England and in the slums of Kingston, Jamaica. She became intrigued by the informal economic system among such communities, where members bought and sold material goods among themselves and also provided goods and services to the larger community on an informal or casual basis. She returned to Kingston each summer for a number of years after receiving her doctorate to detect trends in the everyday life of the slums and discovered that by the late 1980s and early 1990s, these local economies had been influenced by gangs and drug smuggling.

In addition to her scientific papers, Harrison has edited *Black Folks in Cities Here and There* (1988) and *Decolonizing Anthropology: Moving Further toward an Anthropology for Liberation* (1991). She has also been an associate editor of *Urban Anthropology* since 1992 and a consulting editor for *Women and Aging* since 1990. She has been active in civil rights efforts, such as the Kentucky Rainbow Coalition, Black Women Organized for Power (1984–1986), and Alliance Against Women's Oppression (1988–1989). She is a member of the Association of Black Anthropologists (president, 1989–1991) and chair of the International Union of Anthropological and Ethnological Sciences since 1993. In 2004, she was awarded the Society for the Anthropology of North America's (SANA) Prize for Distinguished Contributions to the Critical Study of North America and, in 2007, was honored by the Southern Anthropological Society with the Zora Neale Hurston Award for Mentoring, Service, and Scholarship.

Further Resources

University of Florida. Faculty website. <http://www.clas.ufl.edu/users/fayeharr/>.

Harrison-Ross, Phyllis Ann

b. 1936**Pediatrician, Psychiatrist****Education:** B.S., Albion College, 1956; M.D., Wayne State University College of Medicine, 1959**Professional Experience:** instructor, pediatrics, Cornell Medical School, 1961–1962; fellow, adult psychiatry, Albert Einstein College of Medicine, 1964–1966, instructor, pediatrics and psychology, 1966–1968; assistant professor to professor, clinical psychiatry, New York Medical College, 1968–, emerita**Concurrent Positions:** fellowship, adult psychiatry, Albert Einstein College of Medicine, 1964–1966; director and chief, psychiatry, Metropolitan Hospital Community Mental Health Center, 1973–1999; member, psychiatry, Medical Review Board, New York State Commission of Corrections, 1976–2008, commissioner and chair, 2008–

Phyllis Harrison-Ross is a psychiatrist who pioneered the rehabilitation of children who are considered severely developmentally disabled, emotionally disturbed, or physically disabled. Beginning in the late 1960s, she helped to develop the first programs in physical and mental therapy for the young. Previously, there had not been any school programs for such children, who either remained at home or were institutionalized. She helped to develop programs for learning environments that were then duplicated in the public schools. Harrison-Ross practiced psychiatry in Spanish Harlem and found that poverty was responsible for many of the problems faced by children, such as mental illness, learning disabilities, alcoholism, or living with the effects of child abuse. In her practice, children up to five years of age were treated for phobias that ranged from an inability to speak or a refusal to eat to the dread of walking downstairs. Harrison-Ross has been a prominent public figure in New York, hosting a parent-education television series in the 1970s and, later, co-hosting a radio talk show. She has also worked on mental health and recovery issues for survivors of disasters such as the World Trade Center attacks in 2001 and Hurricane Katrina in 2005.

Harrison-Ross has been a professor of medicine and psychiatry at several institutions, including New York Medical College. For 20 years, she was director and chief of psychiatry at Metropolitan Hospital Community Mental Health Center, and since the 1970s, she has been appointed by several governors to sit on the Medical Review Board of the New York State Commission of Corrections, serving as chair of the Commission since 2008. She has received several awards, including the Leadership in Medicine Award of the Susan Smith McKinney Stewart Medical Society (1978), Award of Merit of the Public Health

Association of New York City (1980), and Solomon Carter Fuller Award of the American Psychiatric Association (2004). She is a Distinguished Life Member of the American Psychiatric Association and a member of Black Psychiatrists of America (president, 1976–1978).

Hart, Helen

1900–1971

Plant Pathologist

Education: student, Lawrence College, 1918–1920; B.A., botany, University of Minnesota, 1922, A.M., 1924, Ph.D., plant pathology, 1929

Professional Experience: instructor, plant pathology, University of Minnesota, 1924–1933, assistant to associate professor, 1933–1947, professor, 1947–1966

Concurrent Positions: agent, division of cereal crops and diseases, U.S. Department of Agriculture, 1923–1933; associate editor, *Phytopathology*, 1938–1940, editor-in-chief, 1944–1951

Helen Hart was a leader among the group of investigators in a department famous for its research on stem rust of cereals at the University of Minnesota. Her research areas were disease resistance in crop plants, cereal rusts, and stem rust of wheat. She was involved in efforts to track and prevent outbreaks of wheat stem rust across the Great Plains, which had a devastating economic impact on farmers, and on the development of rust-resistant varieties of plant in Minnesota. Hart's work and that of her advisees at the University of Minnesota (where she spent her entire career) represents an important and enduring contribution to the study of stem rust of wheat and the challenge of understanding and exploiting pathogen specialization and resistance among cultivated plants.

Hart was interested in science as early as high school, but by the time she completed her undergraduate degree in botany, she was discouraged by male professors from pursuing a career in science due to limited employment opportunities for women. She persisted and was admitted to graduate school and a position as lab assistant. After receiving her master's degree, she began teaching at the University of Minnesota while holding a joint appointment at the division of cereal crops and diseases of the U.S. Department of Agriculture Bureau of Plant Industry for over a decade. She continued to teach at the University of Minnesota at the level of instructor while she completed her doctorate, and then was appointed to a faculty position beginning in 1933.

Hart was very active professionally, serving as associate editor and then editor-in-chief of *Phytopathology*, the principal scientific journal of the American

Phytopathological Society. She was the first female president of the American Phytopathological Society, serving from 1955 to 1956; there was not another woman president of that organization for another 30 years. She received the Elvin C. Stakman Award (named for her mentor at the University of Minnesota) for her work on cereal disease in 1963. In 1965, she was elected a fellow of the American Phytopathological Society, and she was a fellow of the American Association for the Advancement of Science. She also was a member of the American Society of Plant Physiologists.

Further Resources

Gegenhuber, Kurt. "Helen Hart: The First Woman President of the American Phytopathological Society." <http://www.apsnet.org/online/feature/Hart/>.

Harvey, Ethel Browne

1885–1965

Cell Biologist

Education: A.B., Goucher College, 1906; A.M., Columbia University, 1907, Ph.D., zoology, 1913

Professional Experience: private school instructor, science, 1908–1911; assistant, biology, Princeton University, 1912–1913; private school instructor, biology, 1913–1914; Sarah Berliner fellow, University of California, 1914–1915; assistant in histology, medical college, Cornell University, 1915–1916; instructor, biology, Washington Square College, New York University, 1928–1931; investigator, biology department, Princeton University, 1931–1959; Marine Biological Laboratory, Woods Hole Oceanographic Institution, 1959–1965

Concurrent Positions: researcher, Oceanographic Institute, Monaco, 1920–1921; Naples Zoological Station, 1925–1926, 1933–1934, 1937

Ethel Harvey revised the theory of cell division when she showed that cells of sea urchin eggs could divide after their nuclei had been removed. The popular press of the 1930s picked up the story and announced that she had "created life without parents." After she received her doctorate, she spent several years at the University of California and at Cornell in research. Although her husband, Edmund Newton Harvey, was also a biologist who specialized in bioluminescence, they worked independently of each other. She continued her research part-time while her children were young, and in 1928, she taught biology at New York University. Starting in 1931 and spanning most of her career,

she was an independent investigator in the biology department at Princeton. She never was appointed to a full faculty position at the university. The only support she received for her work was office space at Princeton and a share of her husband's workspace at Woods Hole Oceanographic Institution. Her internationally recognized work was unfunded with the exception of one grant in 1937 from the American Philosophical Society. She spent several periods on research at the prestigious Naples Zoological Station between 1925 and 1937.

Harvey published nearly 100 scientific papers and one book, *The American Arbacia and Other Sea Urchins* (1956), still a standard reference for sea urchin embryologists. In 1950, she was the second woman to be named a trustee of the Woods Hole Marine Biological Laboratory. She received numerous awards and honors, including an honorary degree from Goucher College in 1956. She was elected a fellow of the American Association for the Advancement of Science and was a member of the American Society of Naturalists and the American Society of Zoologists. Some early sources refer to her as "Mrs. E. Newton Harvey."

Haschemeyer, Audrey E. V.

b. 1936

Biochemist, Environmental Physiologist

Education: B.S., University of Illinois, 1957; Ph.D., physical chemistry, University of California, Berkeley, 1961

Professional Experience: research associate, biology, Massachusetts Institute of Technology, 1961–1964; assistant biologist, Massachusetts General Hospital, 1965–1969; associate professor, biological science, Hunter College, 1969–1974, professor, biology and biochemistry, 1974–, chair, Department of Biological Science, 1980–

Concurrent Positions: associate, Harvard Medical School, 1967–1969; graduate faculty, City University of New York, 1969–; chief scientist, research vessel Alpha Helix, Caribbean-Pacific, 1978; project director, U.S. Antarctic Research Program, 1978–; chief scientist, U.S. Coast Guard Cutter Polar Star, Ross Sea, 1981; member of corporation, Marine Biological Laboratory, Woods Hole Oceanographic Institution, Massachusetts, 1969–

Audrey Haschemeyer is known for her research on fish in Antarctica for the purpose of learning how temperature changes affect some of the complex life processes

in humans. Under a three-year grant from the National Science Foundation in the 1970s, she studied how fish make specific protein molecules, and measured how long the fish required to produce the protein molecules at various temperatures. Unfortunately, North American fish go into a hibernation state at about 10 degrees Celsius, but she learned that fish in McMurdo Sound do not seem affected by low temperatures. She and her team were able to identify the antifreeze protein in the fish and learned that about half of all the protein in the blood of Antarctic fish is this special protein. The fish have a triggering mechanism that turns off the antifreeze protein in warm weather and turns it on in cold weather. While trying to secure funding for a trip to Antarctica, she took a job in 1978 as the chief scientist aboard the *Alpha Helix*, a research ship operated by the Scripps Institution of Oceanography, and studied tropical fish in the Galapagos Islands.

Haschemeyer was one of the first American women scientists to conduct research in Antarctica. Previously, the only travel and living accommodations for Americans were under the control of the U.S. Navy, and it was only after women scientists from other countries were on-site that the Navy lifted their restrictions against women. In 1981, she was named Outstanding Woman Scientist by the New York Association of Women in Science (AWIS). She is a fellow of the American Association for the Advancement of Science and a member of the American Physiological Society, American Society of Biological Chemists, and Biophysics Society.

Further Resources

Land, Barbara. 1981. *The New Explorers: Women in Antarctica*. New York: Dodd, Mead.

Hatfield, Elaine Catherine

b. 1937

Psychologist

Education: B.A., University of Michigan, 1959; Ph.D., psychology, Stanford University, 1963

Professional Experience: assistant to associate professor, sociology and psychology, University of Minnesota, 1963–1966; associate professor, psychology, University of Rochester, 1966–1967; associate professor to professor, sociology and psychology, University of Wisconsin, Madison, 1967–1981; professor, psychology, University of Hawaii, Manoa, 1981–

Concurrent Positions: research associate, Wisconsin Family Studies Institute, 1980–1981; family therapist, King Kalakua Center, 1982–

Elaine Hatfield is a psychologist known for her research and writings on love, sex, and family life. She has examined a wide range of topics, including some cross-cultural studies of the preferences of men and women in marital partners in the United States, Russia, and Japan, and college students' dating patterns in the three countries. Within the family structure, she has looked at marital equality over the life span of the couple and problems faced by families of developmentally disabled children. She is the co-author of several general psychology texts, such as *Interpersonal Attraction* (1969; 2nd ed., 1978), *Human Sexual Behavior* (1974), and *Introduction to Psychology* (1979). However, her book *A New Look at Love* (1978) brought her popular attention, and the American Psychological Association named her the recipient of their National Media Award in 1979 for this publication.

In 1987, *Mirror, Mirror: The Importance of Looks in Everyday Life* struck a chord with many people who were concerned about contemporary society's emphasis on good looks over integrity and performance. Hatfield begins with defining good looks from culture to culture and ends with discussing the pros and cons of look-improvement campaigns. In Western culture, the experiences of the good-looking and the homely differ greatly, and she showed how looks affect sex, marriage, self-image, personality, and social skills. She authored or co-authored several other books, including *Psychology of Emotion* (1992), *Love, Sex, and Intimacy: Their Psychology, Biology, and History* (1993), *Emotional Contagion* (1994), and *Love and Sex* (1996). *Love, Sex, and Intimacy* was an updated version of the 1978 book *A New Look at Love*, in which Hatfield and her co-author approached the study of relationships from multiple perspectives. They discussed not only heterosexual dating and marital relationships, but also other types of close relationships such as homosexual ones.

Hatfield has received the Distinguished Scientist Award of the Society for Scientific Study of Sex (1994), the award of the Society of Experimental Social Psychology



Psychologist Elaine Hatfield. (Courtesy of Elaine Hatfield)

(1993), and the Alfred Kinsey Award for research into human sexuality (1998). She is a fellow of the American Psychological Association, the Society for the Psychological Study of Social Issues, and the American Sociological Association. She is a member of the Society of Experimental Social Psychology and of the American Association of Sex Educators and Counselors. In some sources, she is listed as Elaine Walster.

Further Resources

“Elaine Hatfield, Ph.D.” <http://www.elainehatfield.com/>.

University of Hawaii. Faculty website. <http://socialsciences.people.hawaii.edu/faculty/?dept=psy&faculty=elaine@hawaii.edu>.

O’Connell, Agnes N. and Nancy Felipe Russo, eds. 2001. *Models of Achievement: Reflections of Eminent Women in Psychology*. Vol. 3. Mahwah, NJ: Lawrence Erlbaum Associates.

Hawkes, Kristen

b. 1944

Anthropologist

Education: B.A., sociology and anthropology, Iowa State University, 1968; M.A., anthropology, University of Washington, 1970, Ph.D., anthropology, 1976

Professional Experience: instructor, Highline Community College, 1970; instructor, anthropology, University of Utah, 1973–1976, assistant to associate professor, 1976–1987, professor, 1987–2001, Distinguished Professor, Department of Anthropology, University of Utah, 2001–

Concurrent Positions: fellow, Center for Advanced Study in the Behavioral Sciences, Stanford University, 2002–2003; collaborative scientist, Division of Psychobiology, Yerkes National Primate Research Center, 2005–

Kristen Hawkes is a physical anthropologist whose areas of specialization include human evolution, behavioral ecology, life cycles, and sociobiology. She developed “the grandmother hypothesis,” an evolutionary explanation for menopause in female humans. Hawkes suggests that infertility in older females confers an evolutionary advantage for the group, in that these women are able to invest more time and attention in raising their own children as well as those of younger women, who also face greater health risks in pregnancy and childbirth. In other words, menopause, or an end to childbearing, allows women to focus their maternal resources on a smaller number of children and grandchildren, ensuring the survival and

education of the next generations, and also preserves group resources (such as food) for a smaller group of younger childbearing women. In her research for over two decades on sex, aging, and life histories among modern hunter-gatherer societies in South America and Africa, Hawkes also found that grandmothers were more important in securing food for young children than males through hunting activities. Her most recent work involves the study of aging and fertility in chimpanzees for further insights into human evolution.

Hawkes earned degrees from Iowa State University before attending graduate school at the University of Washington, where she earned a master's degree in 1970 and a Ph.D. in 1976. She has taught anthropology at the University of Utah throughout her career, and served as chair of the department between 1996 and 2002. She has published numerous articles, encyclopedia entries, and book chapters, and served as editor on Human Evolution for the *Oxford Encyclopedia of Evolution* (2002). Her work on "The Grandmother Effect" was published in *Nature* in 2004.

Hawkes was elected to the National Academy of Science in 2002 and is a fellow of the American Academy of Arts and Sciences. Hawkes has been an invited lecturer and advisory member for institutions in the United States and abroad and has received numerous grants for her work from the National Institutes of Health and National Science Foundation. In 2002, she was awarded the prestigious Rosenblatt Prize from the University of Utah, which included a \$40,000 faculty grant for excellence in interdisciplinary and international scholarship.

Further Resources

University of Utah. Faculty website. <http://www.anthro.utah.edu/faculty/kristen-hawkes.html>.

Hay, Elizabeth Dexter

1927–2007

Embryologist, Cell Biologist, Anatomist

Education: B.A., Smith College, 1948; M.D., Johns Hopkins University, 1952

Professional Experience: intern, University Hospital, Johns Hopkins University, 1952–1953, instructor to assistant professor, anatomy, School of Medicine, 1953–1957; assistant professor, Medical College of Cornell University, 1957–1960; assistant professor, Harvard Medical School, 1960–1964, associate

professor to professor, embryology, 1964–2005, chair, department of anatomy, 1975–1993, professor, cell biology, 1993–2005

Elizabeth Hay was a cell biologist, embryologist, and anatomist whose research on cellular mechanisms aids in the understanding of the metastasis of cancer cells, birth defects, and childhood diseases. Hay and Jean-Paul Revel published a series of papers on their technique of localizing metabolic activities in cells. They demonstrated DNA synthesis in the nucleolus long before the widespread acceptance of the idea that the nucleolus even contained DNA. In 1969, they published a monograph on the structure of the developing avian cornea that has become a classic in the field, and since that time, Hay has concentrated on studies of eye tissues and the functions of collagen and other extracellular matrix molecules.

As an undergraduate, Hay spent her summers working at the Marine Biological Laboratory at Woods Hole, Massachusetts, on limb regeneration. She went to medical school at Johns Hopkins, where she was classmates with **Mary Ellen Avery**. Hay's research concentrated on salamanders and their ability to grow new limbs, and later, on the faculty at Johns Hopkins, she was one of the first researchers to use an electron microscope in the study of biological structure. In 1957, she moved to Cornell to conduct research with Don Fawcett, one of the foremost electron microscopists. When Fawcett moved to Harvard Medical School, Hay began teaching in the same department and continued her studies of limb regeneration. She was the first woman to chair an academic department at Harvard Medical School at a time when there were very few women even on the faculty.

Hay is the author of *Regeneration* (1966) and *Fine Structure of the Developing Avian Cornea* (1969), and editor of *Macro-molecules Regulating Growth and Development* (1974) and *Cell Biology of Extracellular Matrix* (1981; 2nd ed., 1991). She was elected a member of the National Academy of Sciences in 1984. She received the Distinguished Achievement Award of the New York Hospital–Cornell Medical Center Alumni Council (1985), the Alcon Award for Vision Research (1988), the E. B. Wilson Award of the American Society for Cell Biology (1989), the Excellence in Science Award of the Federation of American Societies for Experimental Biology (1990), and the Salute to Contemporary Women Scientists Award of the New York Academy of Sciences (1991), and was the first woman to receive the Society for Developmental Biology's Conklin Medal (1997). She was also the first woman president of both the Society for Developmental Biology (1973) and the American Society of Cell Biology (1976). She was a member of the American Association of Anatomists (president, 1981–1982), American Society of Zoologists (president, 1976–1977), the American Academy of Arts and Sciences, and the International Society of Developmental Biology. Harvard Medical School established a fellowship in her name, and

in 2002, Harvard held a symposium on cell biology in honor of Hay's seventy-fifth birthday.

Further Resources

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

National Institutes of Health. "Dr. Elizabeth Dexter Hay." Changing the Face of Medicine: Celebrating America's Women Physicians. National Library of Medicine. http://www.nlm.nih.gov/changingthefaceofmedicine/physicians/biography_141.html.

Hazen, Elizabeth Lee

1885–1975

Microbiologist

Education: B.S., Mississippi State College for Women, 1910; M.S., Columbia University, 1917, Ph.D., microbiology, 1927

Professional Experience: high school science teacher, 1910–1916; U.S. Army diagnostic laboratories, Alabama and New York, 1917–1926; instructor, College of Physicians and Surgeons, 1927–1931; researcher, New York State Department of Health, 1931–1960; guest investigator, Columbia University Mycology Laboratory, 1960–1973

Elizabeth Hazen was the co-discoverer of the antifungal antibiotic nystatin with **Rachel Brown Fuller**. Hazen was 42 years old when she received her doctorate, but she was recognized as an expert in the diagnosis and treatment of viral and bacterial infections. She was teamed with Brown in 1931, and in 1948, they discovered fungicidin, better known as "nystatin" (named for the New York State Department of Health, where they were employed as researchers). The range of uses for this antibiotic includes combating mold in human and animal food as well as yeast infections of the vagina, intestine, skin, and mucous membranes. It was also used to restore murals and manuscripts in Florence, Italy, following the 1966 flood. After they patented their discovery, they assigned the licensing fees to a foundation to administer research grants under the Brown-Hazen Fund. Hazen was co-author of the book *Laboratory Identification of Pathogenic Fungi Simplified* (1955). After she retired in 1960, she was invited as a guest investigator in the Mycology Laboratory at Columbia.

Together with Rachel Brown, Hazen received the Squibb Award in Chemotherapy (1955), the Sara Benham Award of the Mycological Society of America,

Beatrix Potter

Best known for her beloved children's stories and charming animal illustrations, English author Helen Beatrix Potter (1866–1943) was also a naturalist, conservationist, and mycologist (studier of fungi or mushrooms). She famously spent a privileged but lonely childhood in London and at the family's country home befriending small animals and painting watercolors. She began her career as a science illustrator, read widely in the scientific literature of her day, and formed her own theories, including observations on the symbiotic relationship between fungi and algae on lichens, and on the antibiotic properties of some fungi. She created more than 200 drawings of fungi, and her paper on her experiments in germinating fungi spores was presented to the Linnaean Society of London (although, as a woman, Potter was not allowed to attend or present her own work). Potter thus gained some recognition in England as a mycologist, but discouraged by her family and by Victorian society from pursuing a scientific career, she took up writing and illustrating children's stories instead. Potter, of course, achieved great success and financial independence with *The Tale of Peter Rabbit* and subsequent volumes, which have been translated into several languages. Committed to conservation, farming, and animals, she eventually purchased nearly 4,000 acres, including Hill Top Farm, which she willed to the National Trust for preservation after her death.

the Distinguished Service Award from the New York State Department of Health (1968), and the first Chemical Pioneer Award of the American Institute of Chemists (1975), and she was inducted into the National Inventors Hall of Fame (1994).

Further Resources

Baldwin, Richard S. 1981. *The Fungus Fighters: Two Women Scientists and Their Discovery*. Ithaca, NY: Cornell University Press.

Hazlett, Olive Clio

1890 1974

Mathematician

Education: A.B., Radcliffe College, 1912; M.S., University of Chicago, 1913, Ph.D., mathematics, 1915

Professional Experience: associate, mathematics, Bryn Mawr College, 1916–1918; assistant to associate professor, Mount Holyoke College, 1918–1925; assistant to associate professor, University of Illinois, 1925–1959

Olive Hazlett was an outstanding mathematician in the area of linear algebra and one of the most prolific American women working in mathematics before 1940. After she received her doctorate from the University of Chicago, she was employed for two years at Bryn Mawr. She accepted a position at Mount Holyoke College, achieving tenure there, but then moved to the University of Illinois in order to have the time and the library facilities to pursue her ideas. She was awarded a two-year Guggenheim fellowship for the 1928–1929 academic year to study in Italy, Switzerland, and Germany. In spite of her research and international recognition as a mathematician, she never advanced beyond the level of associate professor in her nearly 45-year career as an academic. This was a common occurrence in mathematics departments at this time, as women faculty usually taught the introductory courses while men taught higher-level courses and advanced to full professorships.

Hazlett was very active in professional societies during the 1920s and 1930s, serving as associate editor of the *Transactions of the American Mathematical Society* from 1923 to 1935 and as a member of the Council of the Society from 1926 to 1928. She was elected a fellow of the American Association for the Advancement of Science and was also a member of the American Mathematical Society and the New York Academy of Sciences.

Further Resources

Agnes Scott College. "Olive Clio Hazlett." Biographies of Women Mathematicians. <http://www.agnesscott.edu/lriddle/women/hazlett.htm>.

Healy, Bernadine Patricia

b. 1944

Cardiologist, Health Administrator

Education: B.A., Vassar College, 1965; M.D., Harvard Medical School, 1970; diplomate, American Board of Medical Examiners, American Board of Cardiology, American Board of Internal Medicine

Professional Experience: medical intern, Johns Hopkins Hospital, 1970–1971, assistant resident, 1971–1972; staff fellow, pathology, National Heart, Blood, and Lung Institute, 1972–1974; fellow, cardiovascular, Johns Hopkins University School of Medicine, 1974–1976, fellow, pathology, 1975–1976, assistant professor to professor, medicine and pathology, 1976–1984, assistant dean, postdoctoral programs and faculty development, 1979–1984; deputy director, Office of Science

and Technology Policy, Executive Office of the President, 1984–1985; chair, Research Institute, Cleveland Clinic Foundation, 1985–1991, Senior Health and Science Policy Advisor, 1994–; director, National Institutes of Health (NIH), 1991–1993; dean and professor, medicine, Ohio State University College of Medicine and Public Health, 1995–1999; president, American Heart Association, 1998–1999; president, American Red Cross, 1999–2001; health editor and columnist, *U.S. News and World Report*, 2003–

Concurrent Positions: member, visiting committee, Board of Overseers, Harvard Medical School and School of Dental Medicine, 1985–1991; member, national advisory board, Johns Hopkins Center for Hospital Finance and Management, 1987–1991; member, Board of Overseers, Harvard College, 1989–; trustee, Edison BioTech Center, Cleveland, 1990–; vice chair, President’s Council of Advisors on Science and Technology, 1990–1991; member, Special Medical Advisory Group, U.S. Department of Veterans Affairs, 1990–1991; chair, Advisory Panel for Basic Research, U.S. Office of Technical Assessment, 1990–1991

Bernadine Healy is a cardiologist and health administrator known for her research in and advocacy of women’s health issues. She was the first woman to head the NIH, from 1991 to 1993, during which time she launched a long-term \$625 million study of 150,000 women known as the Women’s Health Initiative. Probably one of the most significant problems Healy highlighted was that most of the clinical tests of medications were being conducted on adult males, even for medications designed for women and children. She established the policy that the NIH would fund only those clinical trials that included both women and men when the condition being studied affected both sexes. She fought to increase funding for a range of conditions that affect women, such as breast cancer, depression, osteoporosis, and AIDS. Later, as president of the American Heart Association, she emphasized that heart disease was a major killer of women, even though it is often viewed as a male disease and most research funding went to study heart disease only in men.

Healy joined the NIH at a time when the relationship between science and politics was heating up. Congress had banned fetal-tissue research, and Healy brought on more controversy when she approved patent applications for 347 genes, hoping to promote, rather than silence, international research and debate on gene therapy. Healy’s goal throughout her tenure at the NIH was to protect and promote ethical scientific inquiry without political influence, even when it meant objecting to the idea of a Congressional mandate to include women and minorities in clinical trials. Healy preferred to raise awareness about the issue and for scientists to make their trials more inclusive voluntarily, rather than have government “micromanagement” of research trials. In 1999, Healy became head of the American Red Cross and led the agency’s response to the terrorist attacks of September 11, 2001. She

organized the recovery work and created a national program and special funds to attend to the financial and emotional needs of survivors and victims' families, but resigned in late 2001. Since 2003, Healy has written a regular column, "On Health," for *U.S. News and World Report*.

Healy is the author of *Staying Strong and Healthy from 9 to 99* (1995), in which she encourages women to take charge of their health. Her efforts have been honored by the American Heart Association, and she was named a Women's Health Hero by *American Health for Women* magazine (1997) and Humanitarian of the Year by the American Red Cross (1997; co-recipient with her husband, Floyd D. Loops, also a cardiologist). She has received the Democracy in Action Award from the League of Women Voters (1998), the Women Making History Award from the National Museum of Women's History (1998), and the YWCA Women of Achievement Award (1999). She is a member of the Institute of Medicine of the National Academy of Sciences, American Federation for Clinical Research (president, 1983–1984), American Medical Women's Association, and Association of Women in Science.

Further Resources

National Institutes of Health. "Dr. Bernadine Healy." Changing the Face of Medicine: Celebrating America's Women Physicians. National Library of Medicine. http://www.nlm.nih.gov/changingthefaceofmedicine/physicians/biography_145.html.

Bernadine Healy, M.D. *U.S. News and World Report*. <http://www.usnews.com/opinion/bhealy/index.htm>.

Helm, June

1924–2004

Anthropologist, Ethnologist

Education: student, University of Kansas City, 1941; Ph.B., University of Chicago, 1944, M.A., 1950, Ph.D., anthropology, 1958

Professional Experience: lecturer, anthropology, Carleton University, 1949–1959; field officer, Northern Coordination and Research Center, Department of Northern Affairs and Natural Resources, Canada, 1959–1960; assistant professor to professor, anthropology, University of Iowa, 1960–1999

Concurrent Positions: advisor, Indian Brotherhood for Northwest Territories, Canada, 1974; consultant, Mackenzie Valley Pipeline Inquiry, Canada, 1975–1976

June Helm was a sociocultural anthropologist known for her 50 years of ethnographic research and accounts of the Déné Indians, the hunting and gathering people of Canada's Northwest Territories. Her research contradicted that of other anthropologists in the areas of territorial groups, ethnohistory, political leadership, and sociocultural change, and her work offered a continuous and detailed picture of a particular region by combining historical documents with anthropological research. Her early research on the Déné was presented in her doctoral thesis in 1958. Soon after, she began her work on the Dogrib, with whom she worked for the next 25 years and in whose land-reclamation efforts she was involved.

Helm married archaeologist Richard MacNeish in 1945 so she could accompany him to Mexico for his dissertation fieldwork—it was common at the time for researchers who planned to conduct joint fieldwork to marry. At the University of Chicago, she had completed a two-year Ph.B. general education program, then moved to Canada with her husband, who worked for the National Museum of Canada. Accompanying him on a fieldtrip to the Northwest Territories in 1950, Helm (now holding a master's degree) accepted a position to teach English to children of the Slave Indians, a division of the Déné/Athabaskan people, which gave her an entrée to the community as an ethnologist and opened up a career-long study for her. While completing her Ph.D., she also held a lectureship at Carleton University but, after receiving her doctorate in 1958, the same year the couple divorced, she accepted a position at the University of Iowa. At Iowa, she helped establish a separate anthropology department and oversaw the creation of the American Indian Native Studies program. She taught at Iowa for nearly 40 years, continuing to meet with and advise students even after suffering a stroke in 1989.

Helm published several books, including *Lynx Point People: The Dynamics of a Northern Athapaskan Band* (1961) and *Indians of the Subarctic* (1976), *Social Contexts of American Ethnology, 1840–1984* (1985), *Prophecy and Power among the Dogrib Indians* (1994), and *The People of Denendeh: Ethnohistory of the Indians of Canada's Northwest Territories* (2000). She also edited a volume on the Subarctic for the *Handbook of North American Indians*, published by the Smithsonian (1981). She was a member of the Ethnological Society of America (president, 1981–1983), a fellow of the American Association for the Advancement of Science and the American Anthropological Association (president, 1985–1987), and elected to the American Academy of Arts and Sciences (1994). She was also honored for her teaching excellence at the University of Iowa with the Regents' Award for Faculty Excellence (1995) and as the F. Wendell Miller Distinguished Professor of Anthropology (1996–1999).

Further Resources

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- University of Iowa. "June Helm (1924–2004)." Reprinted from American Anthropological Association, *Anthropology News*, 45(4): 28–29. <http://www.clas.uiowa.edu/faculty/memorials/helm.shtml>.
- Gacs, Ute et al. 1988. *Women Anthropologists: Selected Biographies*. Westport, CT: Greenwood Press.

Herzenberg, Caroline Stuart (Littlejohn)

b. 1932
Physicist

Education: B.S., Massachusetts Institute of Technology, 1953; M.S., University of Chicago, 1955, Ph.D., physics, 1958

Professional Experience: research associate, nuclear physics, University of Chicago, 1958–1959; research associate, Argonne National Laboratory, 1959–1961; assistant professor, physics, Illinois Institute of Technology (IIT), 1961–1967; research physicist to senior physicist, IIT Research Institute, 1967–1971; consultant, 1971–1972; visiting associate professor, physics, University of Illinois Medical Center, 1972–1974; consultant, 1974–1975; lecturer, physics, California State University, Fresno, 1975–1976; physicist, Argonne National Laboratory, 1977–2001; consultant, 2001–

Caroline Herzenberg is a physicist known for her pioneering research on the Mossbauer effect, for studying the first lunar samples returned to Earth from the Apollo missions, and for developing analytic instruments for fossil-fuel studies. In addition, she has publicized the accomplishments of women scientists and worked to further the science careers of young women. She measured the products of nuclear reactions between lithium isotopes and those of lithium, beryllium, and boron. These studies pioneered some of the earliest heavy-ion work. As a postdoctoral fellow at the Argonne National Laboratory, her research focus shifted to Mossbauer spectroscopy. She and several colleagues verified the existence of and went on to do pioneering work on the Mossbauer effect (named in the 1950s after Rudolph Mossbauer), which is the phenomenon whereby the atom in a crystal undergoes no recoil when emitting a gamma ray, giving all the emitted energy to the gamma ray and resulting in a sharply defined wavelength.

At the Illinois Institute of Technology, Herzenberg set up a Mossbauer-effect research facility and began to explore geological applications of the effect. She published the spectra of different rock types, noting the potential for using the Mossbauer spectrometry technique to analyze rocks and minerals from lunar and planetary surfaces. She submitted a proposal to the National Aeronautics and Space Administration (NASA) and was appointed a principal investigator for analyzing the lunar samples from the Apollo missions. Since the Mossbauer technique requires minute samples for nondestructive testing, it was an ideal analytical technique. Her group clearly identified the presence of free metallic iron and ilmenite, and verified the presence of other iron-containing minerals in the lunar samples. Even with a lucrative grant from NASA, she was denied tenure at IIT and moved on to other research positions and work as a consultant before settling at the Argonne National Laboratory. At Argonne, she joined a fossil-energy instrumentation program that focused on developing instrumentation for process control of a new generation of coal conversion and combustion plants. She developed nuclear techniques for noninvasive measuring of the composition and flow rate of coal slurries and pulverized coal in pneumatic transport pipes, studying applications for fossil-energy utilization, radioactive waste disposal, technology for arms-control verification, and radiological emergency preparedness. Since her retirement from Argonne in 2001, she has been an independent consultant and speaker.

In 1989, she was the first scientist to be inducted into the Chicago Women's Hall of Fame. In addition to her scientific publications, she published *Women Scientists from Antiquity to the Present* (1986), a compendium of sources for information about women scientists throughout history. She co-authored with Ruth H. Howes *Their Day in the Sun: Women of the Manhattan Project* (1999), an overview of the many female physicists, chemists, mathematicians, and others who worked on the World War II-era development of the atomic bomb. Herzenberg is a fellow of the American Association for the Advancement of Science and the American Physical Society. She is a member of the Association of Women in Science (president, 1988–1990) and the Federation of American Scientists.

Hewlett, Sylvia Ann

b. 1946

Economist

Education: B.A., Cambridge University, 1967, M.A, 1971; Ph.D., economics, London School of Economics and Political Science, 1973

Professional Experience: research fellow, Cambridge University, 1972–1974; assistant professor, economics, Barnard College, 1979–1981; vice president for Economic Studies, United Nations, 1981–1986; independent author, 1986–; chair and founding president, Center for Work-Life Policy (formerly National Parenting Association), 1993–

Concurrent Positions: adjunct faculty, Gender and Policy Program, School of International and Public Affairs, Columbia University

Sylvia Hewlett is a feminist economist who examines the status of women and the family in American society. Her chief argument throughout her various works is that in the drive for equality in the workplace, feminists ignored the fact that many women want to be mothers and therefore did not demand paid medical and maternity leaves, tax exemptions for children, or government-funded childcare, guarantees that are prevalent in many European countries. Hewlett's interest in this topic began with her own experience as a new professor in the early 1980s when she was surprised to learn she had only a few weeks paid leave after the birth of her first child. She worked to establish maternity leave policy and childcare facilities at her institution, only to be discouraged by both male and female colleagues. Frustrated with the tenure requirements for a woman with a family, she left academia for a position with the United Nations as vice president for economic studies.

Although she published several early books on South American fiscal policy, Hewlett is best known for her studies of feminism and economic policy. In the controversial *A Lesser Life: The Myth of Women's Liberation in America* (1986), she argued that the feminist focus on the Equal Rights Amendment was misguided and irrelevant to most American women. She believed that feminists in the 1970s ignored the realities of family life by not attempting to enact family-friendly legislation. She followed up with *When the Bough Breaks: The Cost of Neglecting Our Children* (1991) and *The War against*



Economist and feminist Sylvia Hewlett has written several books on the status of women and the family in American society. (Erica Berger/Corbis)

Parents: What We Can Do for America's Beleaguered Moms and Dads (1998; co-authored with Cornel West), providing data on the wage gap between women and men, the low income of divorced women with children, and the lack of adequate prenatal care and childcare facilities in this country that makes raising children nearly economically impossible for many Americans. Her other books include *Creating a Life: What Every Woman Needs to Know about Having a Baby and a Career* (2004) and *Off-Ramps and On-Ramps: Keeping Talented Women on the Road to Success* (2007), both of which deal with the economic and social costs of women taking time off from careers to raise families and obstacles on trying to reenter the workforce. Her most recent book is *Top Talent: Keeping Performance Up When Business Is Down* (2009).

Hewlett continues her focus on these concerns as director of the Center for Work-Life Policy, a nonprofit organization (founded in 1993 as the National Parenting Association) focused on policy issues related to work and family life, and heads a task force of global corporations on the issue of hiring and retaining female and minority talent. In 2008, the Center released a report on "The Athena Factor: Reversing the Brain Drain in Science, Engineering, and Technology." Hewlett has maintained a highly visible presence in the media to talk about these issues and has appeared on numerous television and news outlets, including *60 Minutes*, *The Today Show*, *Good Morning America*, *Oprah*, and NPR.

Further Resources

"Sylvia Ann Hewlett." <http://www.sylviaannhewlett.com/>.

"Center for Work-Life Policy." <http://www.worklifepolicy.org/>.

Hibbard, Hope

1893 1988

Zoologist, Marine Biologist

Education: A.B., University of Missouri, 1916, A.M., 1918; Ph.D., zoology, Bryn Mawr College, 1921, Sarah Berliner fellow, 1925–1926; D.es Sc., zoology, University of Paris (Sorbonne), Paris, 1928

Professional Experience: demonstrator, biology, Bryn Mawr College, 1919–1920; associate professor, Elmira College, 1921–1925; preparateur, comparative anatomy techniques laboratory, University of Paris, 1926–1927; fellow, International

Education Board, 1927–1928; assistant to associate professor, zoology, Oberlin College, 1928–1933, professor, 1933–1961

Hope Hibbard was recognized by her contemporaries for her research on the cytology (or cell biology) and tissue studies of marine invertebrates, such as limpets, worms, squid, and the Golgi apparatus. After receiving her doctorate from Bryn Mawr on the fertilization of sea urchin eggs, she was employed as a demonstrator in biology at the school for one year. She then taught at Elmira College as associate professor for four years before traveling to the University of Paris (the Sorbonne) on a postgraduate fellowship from the American Association of University Women (AAUW). She remained in Paris on another fellowship from the International Education Board and received another doctorate there in 1928.

She returned to the United States and was appointed assistant professor of zoology at Oberlin College, where she spent the remainder of her career, advancing to full professor and serving for four years as department chair. In addition to her duties at Oberlin, she also served as a trustee at the Woods Hole Marine Biological Laboratory in Massachusetts.

Hibbard was a member of several professional societies, including the American Association for the Advancement of Science, the AAUW, the American Society of Naturalists, and the American Society of Zoologists. She was particularly concerned about the role of women in science and gave numerous lectures for the AAUW and other organizations on women's education and employment prospects.

Further Resources

Papers of Hope Hibbard. Oberlin College archives. <http://www.oberlin.edu/archive/resources/women/group30.html>.

Hicks, Beatrice Alice

1919–1979

Engineer

Education: B.S., chemical engineering, Newark College of Engineering, 1939; M.S., physics, Stevens Institute of Technology, 1949

Professional Experience: research assistant, Newark College of Engineering, 1939–1942; researcher, design and manufacturing, Western Electric Company, 1942–1945; chief engineer, Newark Controls Company, 1945–1946, vice president and chief engineer, 1946–1955, president, 1955–1966; head, Rodney D. Chipp and Associates, 1967–1979

Beatrice Hicks was one of the few early women scientists who owned their own companies. When her father died, Hicks became vice president and chief engineer of the family-owned Newark Controls Company, a company founded by her engineer father. She later bought control and became president of the company, which designed and manufactured temperature-sensing devices and controls to meet specific environmental specifications. She began her career as a research assistant after receiving her chemical engineering degree from Newark College of Engineering (later the New Jersey Institute of Technology). She accepted a position first as a technician and then in research design and manufacturing as one of the first female engineers at Western Electric Company in 1942. (During World War II, many corporations hired their first women scientists and engineers in professional positions due to the shortage of available men.) After taking over her father's company, she went on to earn her master's degree in physics from Stevens Institute and took further graduate work in electrical engineering at Columbia University. She sold Newark Controls after her husband, Rodney Chipp, died in 1966, and she took over running his engineering consulting firm. She later established a Rodney D. Chipp Award from the Society of Women Engineers (SWE) for individuals or companies that promoted women in high-level engineering positions.

Hicks was one of the founders of SWE and was the first president, serving from 1950 to 1953. In 1964, she was director of the SWE's First International Conference of Women Engineers and Scientists. Hicks was elected to the National Academy of Engineering in 1978. She received honorary degrees from Hobart and William Smith Colleges (1958), Rensselaer Polytechnic Institute (1965), Stevens Institute of Technology (1978), and Worcester Polytechnic Institute (1978). She was chosen Alumna of the Year for Newark College of Engineering (1962) and received the SWE Achievement Award (1963). She was a member of the Institute of Electrical and Electronics Engineers, National Society of Professional Engineers, and American Society of Mechanical Engineers.

Hockfield, Susan

b. 1951

Neuroscientist

Education: B.S., biology, University of Rochester, New York, 1973; Ph.D., neuroscience and anatomy, Georgetown University School of Medicine, 1979; M.A., Yale University, 1994

Professional Experience: National Institutes of Health postdoctoral fellow, anatomy and neuroscience, University of California, San Francisco, 1979–1980; junior staff investigator, Cold Spring Harbor Laboratory, New York, 1980–1982, senior staff investigator, 1982–1985; assistant professor, neurobiology, Yale University School of Medicine, 1985–1989, associate professor, 1989–1994, professor, 1994–2004 (William Edward Gilbert Professor of Neurobiology, 2001–2004), provost, Yale University, 2003–2004; president and professor, neuroscience, Massachusetts Institute of Technology (MIT), 2004–

Susan Hockfield is a neurobiologist who, in 2004, became the first woman president of MIT. She is also the first life scientist to be president of MIT, which was founded in 1865 and known for its engineering and physical sciences programs. Hockfield received her undergraduate degree in biology from the University of Rochester, intending to become a physician, and went on to earn a doctorate in neuroscience and anatomy from Georgetown University in 1979. As a graduate student, she researched pain and the nervous system. She was a staff scientist and summer neurobiology program director at Cold Spring Harbor Laboratory in New York for five years and worked with Nobel Prize-winning geneticist James Watson. In 1985, she joined the faculty of Yale University Medical School, where she also eventually earned a master's degree in administration and became dean of graduate studies and then provost. In addition to these administrative duties, she continued her own scientific research on mammalian brain cells and brain tumors, work for which she holds at least three patents. She has served on numerous advisory committees for academic, corporate, and government boards. She was recruited to MIT as president in 2004.

Hockfield is a fellow of the American Academy of Arts and Science, American Association for the Advancement of Science, and Council on Foreign Relations. She is a member of the Society for Neuroscience and



Susan Hockfield, the first female president at the Massachusetts Institute of Technology 2004. (AP/Wide World Photos)

the recipient of the Charles Judson Herrick Award of the American Association of Anatomists (1987), Wilbur L. Cross Medal from Yale (2003), Meliora Citation for Career Achievement from the University of Rochester (2003), and Citation Award from the Midwest Research Institute. She has also received honorary doctorates from Tsinghua University, China (2006), Watson School of Biological Sciences at Cold Spring Harbor Laboratory (2006), Brown University (2006), Mount Sinai School of Medicine at New York University (2009), and University of Edinburgh, Scotland (2009).

Further Resources

Massachusetts Institute of Technology. "Susan Hockfield: President, Massachusetts Institute of Technology." <http://web.mit.edu/hockfield/>.

Hoffleit, (Ellen) Dorrit

1907–2007

Astronomer

Education: A.B., Radcliffe College, 1928, M.A., 1932, Ph.D., astronomy, 1938

Professional Experience: assistant, Harvard Observatory, 1929–1938, research associate, 1938–1943; mathematician, ballistic research laboratories, Aberdeen Proving Ground, 1943–1948; astronomer, Harvard Observatory, 1948–1956; research associate, Yale Observatory, 1956–1969, senior research astronomer, 1969–1975

Concurrent Positions: technical consultant, Aberdeen Proving Ground, 1948–1961; lecturer, Wellesley College, 1955–1956; director, summer programs, Maria Mitchell Observatory, 1956–1978

Dorrit Hoffleit was an astronomer who discovered 1,000 new variable stars and studied their modes of variation. She began working for the Harvard Observatory in 1929 after receiving her undergraduate degree from Radcliffe, and she continued on the staff while receiving her master's degree and doctorate. In 1943, she was hired as a mathematician at Aberdeen Proving Ground, continuing there as a technical consultant from 1948 to 1961. (Many female scientists during World War II were hired by government agencies or under government contracts due to the wartime shortage of male scientists. Some continued in these positions, some continued to consult, and some went on to other work.) She returned to the Harvard Observatory as an astronomer in 1948 and moved to the Yale Observatory

in 1956. From 1956 to 1978, she had a concurrent appointment as the director of the Maria Mitchell Observatory at Nantucket, Massachusetts. Even though she officially retired from Yale in 1975, she maintained office hours and continued her research well into her nineties. Hoffleit lived to celebrate her hundredth birthday.

In addition to her scientific papers, Hoffleit published two books: *Some Firsts in Astronomical Photography* (1950) and *Bright Star Catalogue* (1964). She was president of the American Association of Variable Star Observers (AAVSO) from 1961 to 1963 and was editor of the journal *Meteoritics*. One of her interests was the history of astronomy in the nineteenth and twentieth centuries. She wrote biographical sketches of Maria Mitchell, Williamina Fleming, and **Annie Cannon** for several reference books and, in 1992, published a history, *Astronomy at Yale, 1701–1968*. She also wrote an autobiography, *Misfortunes as Blessings in Disguise: The Story of My Life*, published by AAVSO in 2002. Hoffleit contributed news items and occasional book reviews to *Sky & Telescope* magazine from the early 1940s until her final submission in 1997, at the age of 90 years old. She received the George Van Biesbroeck Prize (1988) and the Annenberg Prize (1993), both of the American Astronomical Society. She was a member of the American Association for the Advancement of Science, Meteoritical Society, International Astronomical Union, and American Astronomical Society.



Astronomer Dorrit Hoffleit, author of one of the most used catalogs on the cosmos. (AP/Wide World Photos)

Hoffman, Darleane (Christian)

b. 1926

Nuclear Chemist

Education: B.S., Iowa State University, 1948, Ph.D., physical chemistry, 1951

Professional Experience: assistant, Ames Laboratory, U.S. Atomic Energy Commission, 1947–1951; chemist, Oak Ridge National Laboratory, 1951–1952; staff member, Associate Group Leader, Division Leader of Chemistry and Nuclear Chemistry and Isotope and Nuclear Chemistry Divisions, Los Alamos National Laboratory, 1952–1984; professor, chemistry and senior scientist, Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, 1984–; director, Glenn T. Seaborg Institute of Transactinium Science, Lawrence Livermore National Laboratory, 1991–1996; Senior Advisor and Charter Director, Seaborg Institute, 1996–

Darleane Hoffman is a major international figure in nuclear chemistry who, in her early research on the separations processes of the heavy elements, developed techniques that still are in use today. Her original interest in chemical separations made her a leading figure in the studies of the heaviest elements. She was a project leader of the radionuclide migration project at the Nevada test site in 1975 to determine the potential for radionuclide migration away from the site of underground nuclear tests. Her findings later led to the Nevada Nuclear Waste Storage Investigation Program to find a suitable site for an underground nuclear repository at the Nevada test site. It was also at Los Alamos that she discovered plutonium-244 in nature. Her group performed the first aqueous chemistry on hahnium (element 105) using the longest known isotope, which has a half-life of only 35 seconds. In collaboration with German and Swiss scientists, her group produced and studied isotopes of element 103 (Lr) and element 105 as Ha-262 and Ha-263. In 1999, her group discovered the first super-heavy elements, 118, 116, and 114.

While still an undergraduate, Hoffman received a research assistantship at Iowa State University's Institute of Atomic Research and became fascinated with the study of radioactivity. She continued at Iowa State as a graduate student and met her future husband there; they married shortly after she received her doctorate in 1951. When she accepted a position at Oak Ridge National Laboratory, her husband, Marvin Hoffman, remained at Ames to complete his degree in physics; they both moved to Los Alamos after he completed his degree. Over the course of her long career, she conducted her research at all of the major national laboratories, and in 1991, she became director of the Seaborg Institute of Transactinium Science at the Lawrence Livermore National Laboratory. She was a member of the Cold Fusion Panel of the Department of Energy to examine claims to the discovery of cold fusion (1989–1990).

Hoffman was awarded the National Medal of Science in 1997. She was the first woman to receive the Award for Nuclear Chemistry of the American Chemical Society (ACS) (1983), and she was awarded the Garvan Medal of the ACS (1989),

the ACS Priestley Medal (2000), and the Mosher Award of the ACS (2000). She is a fellow of the American Institute of Chemists, the American Physical Society, and the American Academy of Arts and Sciences, and a member of the American Chemical Society and the American Association for the Advancement of Science. In 2000, she was inducted into the Women in Technology International Hall of Fame.

Further Resources

University of California, Berkeley. Faculty website. <http://chem.berkeley.edu/faculty/hoffman/index.php>.

Hollingworth, Leta Anna Stetter

1886–1939

Psychologist

Education: B.A., University of Nebraska, 1906; M.A., education, Columbia University, 1913, Ph.D., educational psychology, 1916

Professional Experience: high school teacher, 1906–1908; clinical psychologist, Bellevue Hospital, 1914–1916; instructor, Teachers' College, Columbia University, 1917–1928, professor, 1929–1939

Leta Hollingworth published on the psychology of women and children, and was particularly interested in educational psychology and testing. At a time when it was commonly considered that men were intellectually superior to women, she measured sex differences in selected traits and types of performance to show that women could function as well as men in educational and professional pursuits. Hollingworth never had children, but in a 1927 article on “The New Woman in the Making,” she explained the biological and psychological dilemma for women as they grappled with the question of “[h]ow to reproduce the species and at the same time to win satisfaction of the human appetites for food, security, self-assertion, mastery, adventure, play, and so forth.” These studies made her popular in feminist circles, and she and her husband marched in suffrage parades. She felt that reform in attitudes would do as much to improve women's status as political reform. Hollingworth had originally planned to be a writer, but decided to obtain a teaching certificate in order to support herself. She married in 1908 and moved with her husband, Harry L. Hollingworth, to New York, where he completed his graduate degree and became a faculty member at Barnard. Finding no writing or teaching job for a married woman, she decided to further her education, beginning

with graduate courses in literature but soon developing an interest in psychology. She eventually combined her interests in education and psychology by accepting a position in the psychology department of Teachers College in 1917, where she remained the rest of her career, eventually achieving the level of professor.

While pursuing her doctorate at Columbia, Hollingworth had worked part-time administering intelligence tests at the Clearing House for Mental Defectives and then as a clinical psychologist at Bellevue Hospital, where she began her work on adolescents. In 1914, she was appointed to fill New York City's first civil service position for a psychologist. This early work in New York hospitals and schools led to an interest in the mental abilities and special educational needs of children. Her books on the topic were widely read and represented significant contributions to the field. These included *The Psychology of Subnormal Children* (1920), *Special Talents and Defects* (1923), and her two books on gifted children, *Gifted Children* (1926) and *Children above 180 I. Q.* (1942, published posthumously). Her textbook on *The Psychology of the Adolescent* (1928) became the standard taught in college courses. At Teachers College, she established a guidance laboratory to carry out testing and counseling, and she consulted for school systems to obtain research data. She was instrumental in establishing in 1936 the Speyer School in the New York City School system to study exceptional children.

Although she spent her career in New York, she was the daughter of migrants to the prairie and had strong ties to her home state of Nebraska, where she was raised in a sod house and educated in a one-room school. She received an honorary degree from the University of Nebraska in 1937. After her death, a collection of her poetry was privately published as *Prairie Years* (1940) and her husband wrote a biography, *Leta Stetter Hollingworth* (1943).

Hollinshead, Ariel Cahill

b. 1929

Pharmacologist, Cancer Researcher

Education: B.A., zoology, Ohio University, 1951; M.A., George Washington University, 1955, Ph.D., pharmacology, 1957

Professional Experience: postdoctoral research fellow, virology, Baylor University Medical Center, Texas, 1958–1959; assistant to associate professor, pharmacology, George Washington University, 1959–1973, professor, medicine, George Washington Medical Center, 1974–1991, research professor emerita

Concurrent Positions: director, Laboratory for Virus and Cancer Research, George Washington University, 1964–1989

Ariel Hollinshead was the first person to identify animal and human antigens in cancerous tumors, and she is also the first to purify, develop, and test cancer-gene chemotherapy products that induce long-lasting cell-mediated immunity. In her research, she devised a new technique for isolating the antigens intact from the membranes by using low-frequency sound, which gently separates out the antigens without damaging them. She began her career investigating vaccines for human lung cancer, moved into the field of ovarian cancer in the 1980s, and then worked on developing new forms of HIV and AIDS therapy. She spent her entire career at George Washington University and Medical Center, where she taught pharmacology, immunology, virology, and oncology. She also founded and then directed the Laboratory for Virus and Cancer Research for nearly 25 years.

Hollinshead began her undergraduate career at Swarthmore College, but transferred to Ohio University, where she studied zoology and chemistry. After receiving her bachelor's degree in 1951, she began graduate work at George Washington University, earning both a master's degree and a Ph.D. in pharmacology. She spent a year as a postdoctoral fellow in virology at Baylor University in Texas, then moved to Washington, D.C., to begin her long affiliation with George Washington University. She has also been committed to science education and careers for women, and established the group Professional Opportunities for Women in Science (POWS).

Hollinshead was the first woman appointed to chair the Review Board of Oncology for the Veterans Administration in 1977. Among her awards are the Medical Woman of the Year Award of the Board of American Medical Colleges (1975), the Star of Europe Medal (1980), an honorary doctorate from her alma mater, Ohio University (1980), and Italy's Scholar Speciale Medicina Silver Medal (1990). She is a fellow of the American Academy of Microbiology and American Association for the Advancement of Science, and a member of the New York Academy of Sciences, International Society for Preventive Oncology, National Society for Experimental Biology and Medicine, American Society for Microbiology, American Association of Cancer Research, American Association of Immunologists, and American Medical Writers Association.

Hopper, Grace Murray

1906–1992

Mathematician, Computer Scientist

Education: B.A., math and physics, Vassar College, 1928; M.A., Yale University, 1930, Ph.D., mathematics, 1934

Professional Experience: assistant, mathematics, Vassar College, 1931–1934, instructor, 1934–1939, assistant to associate professor, 1939–1946; research fellow, engineering science and applied physics, Computational Laboratory, Harvard University, 1946–1949; systems engineer, UNIVAC Division, Eckert-Mauchly Corporation (later Remington Rand and Sperry), 1949–1953, director, Automatic Programming, 1953–1959, chief engineer, 1959–1961, staff scientist, 1961–1971; Special Advisor to Commander, Naval Data Automation Command, U.S. Department of Navy, 1967–1986; consultant, Digital Equipment Corporation, 1986–1992

Concurrent Positions: adjunct professor, Moore School of Electrical Engineering, University of Pennsylvania, 1963–1971; professor, George Washington University, 1971–1978

Grace Hopper was a mathematician whose achievements in the design of software for digital computers spanned three computer generations. She is best known for her contribution to early programming languages, in particular the development of COBOL (or Common Business Oriented Language), a more accessible programming language intended for universal business applications. After receiving her undergraduate degree from Vassar College in 1928, she taught mathematics there for 15 years, rising through the ranks to associate professor, and completing both a master's and a doctorate in mathematics from Yale University. During World War II, she took a leave of absence to join the U.S. Navy's Women Accepted for Voluntary Emergency Services (WAVES), where she spent three years working on ordnance problems at the Harvard computer laboratory. In 1946, she resigned from Vassar to take an assistantship at Harvard to continue work on computer software. She had joined the U.S. Naval Reserves in 1943 and it was under these auspices that she worked on the Bureau of Ships Computation Project at Harvard, developing a programmable digital computer for the Navy. She then moved to the Eckert-Mauchly Corporation (which sold to Remington Rand, then Sperry, and much later became known as Unisys) to head its automatic programming section for the UNIVAC computer.

Hopper retired officially in 1971 and taught for several years at George Washington University before returning to active military duty for what was essentially a second phase of her career designing computer software as head of the programming language section. By the time she retired a second time in 1986, she was the oldest officer on active duty in the Navy to hold the rank of commodore (subsequently changed to rear admiral). In 1996, four years after her death, the U.S. Navy missile destroyer ship, the *USS Hopper* (nicknamed "Amazing Grace"), was launched in memory of her service and contributions to

computer science. In addition to her numerous conference papers and journal articles, Hopper co-authored a textbook, *Understanding Computers* (1984).

Hopper was elected to the National Academy of Engineering in 1973. She received honorary degrees from at least 10 universities in the United States and abroad. She received an Achievement Award of the Society of Women Engineers (1964) and was named “Man of the Year” by the Data Processing Management Association (1969). Hopper received many of her highest honors and recognition after her retirement, including the Defense Distinguished Service Medal (1986), a Computer History Museum Fellow Award (1987), and the National Medal of Technology (1991). In 1971, the Association for Computing Machinery (ACM) created the Grace Murray Hopper Award for Outstanding Young Computer Professionals in her name. She was a fellow of the American Association for the Advancement of Science, Institute of Electrical and Electronics Engineers, Franklin Institute, Association of Computer Programmers and Analysts, Association for Computing Machinery, and in 1973 was the first American (and first woman) named a Distinguished Fellow of the British Computer Society.

Further Resources

- Williams, Kathleen Broome. 2001. *Improbable Warriors: Women Scientists and the US Navy in World War II*. Annapolis, MD: Naval Institute Press.
- Williams, Kathleen Broome. 2004. *Grace Hopper: Admiral of the Cyber Sea*. Annapolis, MD: Naval Institute Press.

Horner, Matina (Souretis)

b. 1939

Psychologist

Education: B.A., Bryn Mawr College, 1961; M.S., University of Michigan, 1963, Ph.D., psychology, 1968

Professional Experience: lecturer, University of Michigan, 1968–1969; lecturer, social relations, Harvard University, 1969–1970, assistant professor, clinical psychology, 1970–1972, consultant, University Health Services, 1971–1989; associate professor, psychology, 1972–1989, president, Radcliffe College, 1972–1989; executive vice president, TIAA-CREF, 1989–2003

Matina Horner is known for her research on the analysis of achievement motivation among women. She theorized that many highly intelligent women fear that

academic or business success will undermine their femininity and that they will be criticized for their ambition rather than encouraged in it. Such women develop strong anxieties and unconsciously underachieve. Horner started her study of achievement motivation while still an undergraduate in the late 1950s; while conducting research for her doctorate in the 1960s, she found that although male students were confident they would achieve success in work, life, and family, female students were inconsistent in their replies. The mixed message that young women should do well academically but ultimately define success through marriage and family rather than personal achievement may cause the fear-of-success syndrome.

As a psychology professor, Horner found that although Radcliffe women were highly intelligent and successful at college, they were not going on to high-profile careers. Her research revealed that male Harvard students held images of Radcliffe women as dull, uninteresting, and unattractive, and that the self-esteem of female students suffered from such stereotypes. She advocated building women's confidence during the college years while helping men learn to be more comfortable working alongside successful women. As president of Radcliffe, Horner worked to integrate the academic and social lives of students at the two schools. She came to Radcliffe at the age of only 32, the youngest president in the college's history. She left in 1989 to become executive vice president of TIAA-CREF, a private retirement insurance agency for educators.

Horner has received 20 honorary degrees. She is a member of the American Psychological Association and the American Association for the Advancement of Science, and serves on the Board of Directors of the Women's Research and Education Institute (WREI).

Horning, Marjorie G.

b. 1917

Pharmacologist, Biochemist

Education: B.A., Goucher College, 1938; M.S., University of Michigan, 1940, Ph.D., biological chemistry, 1943

Professional Experience: research associate, pediatrics, University of Michigan Hospital, 1944–1945; research chemist, University of Pennsylvania, 1945–1950; biochemist, National Heart Institute, 1951–1961; associate professor, biochemistry, College of Medicine, Baylor University, Texas, 1961–1969, professor, biochemistry, Institute for Lipid Research, 1969–retired

Concurrent Positions: adjunct professor, biochemical and biophysical sciences, University of Houston

Marjorie Horning is renowned for her pioneering research on techniques for studying how drugs are broken down and used by the human body. In the 1960s and 1970s, she researched the transfer of drugs from a pregnant woman to her child. As late as 1968, the placenta was considered a barrier that kept the fetus from harm, but Horning showed that virtually every drug taken by a pregnant woman reaches her unborn child, either in its original form or broken down into by-products. She also found that drugs taken by a nursing mother reach the child through breast milk. This research laid the foundation for subsequent work in preventing drug-induced birth defects, and linking pregnancy health to later behavioral or learning problems. Horning's research had significant implications during the 1980s and 1990s, when the number of babies who were born with drug or alcohol addiction increased. Armed with research that even nonprescription medications such as aspirin could be passed on to the fetus with potentially harmful effects, doctors began to warn pregnant women to avoid alcohol, drugs, and cigarettes completely during pregnancy, and to limit their use even before conception.

Horning's research methods were also pathbreaking. She and her husband, Evan Horning, were at the forefront of applying gas chromatology to the solution of biological problems in the 1950s, and their use of trace analysis by gas chromatography was a major breakthrough for the field of analytical biochemistry in the early 1960s. Later, Horning used mass spectrometry to identify the metabolic switching of drug pathways, and she has worked with the atmospheric pressure ionization mass spectrometer, which allows detection at minute levels. The Hornings received the Outstanding Achievement in Mass Spectrometry Award from the American Chemical Society in 1989.

Horning has received the Garvan Medal of the American Chemical Society (1977), and she and her husband shared the Warner-Lambert Award of the American Association of Clinical Chemists (1976). She is a member of the American Association for the Advancement of Science, American Chemical Society, and New York Academy of Sciences. She was also a member of the American Society of Pharmacology and Experimental Therapeutics (ASPET), and served as the first female president of that organization in 1984.

Horstmann, Dorothy Millicent

1911–2001

Epidemiologist

Education: A.B., University of California, Berkeley, 1936; M.D., University of California, San Francisco, 1940

Professional Experience: fellow, School of Medicine, Yale University, 1942–1943, instructor, preventive medicine, 1943–1947; instructor, University of California, San Francisco, 1944–1945; senior fellow, University of London, 1947–1948; assistant to associate professor, preventive medicine, Yale, 1948–1956, associate professor, preventive medicine and pediatrics, 1956–1961, professor, epidemiology and pediatrics, 1961–1982, emeritus professor and senior research scientist, 1982–2001

Dorothy Horstmann conducted research on polio and rubella, and established many of the important characteristics of polio that aided in the eventual development of a vaccine. In particular, she discovered that the polio virus traveled to the brain through the bloodstream, rather than through nerve cells as previously thought. After earning an undergraduate degree from Berkeley, she received her medical degree from the University of California, San Francisco in 1940. In 1948, she joined the faculty at Yale University, where she spent more than 50 years as a professor of preventive medicine, epidemiology, and pediatrics. In the 1940s, there still was reluctance to hire women as faculty members, but she advanced in faculty rank at four-year intervals, a truly remarkable achievement that indicates the superiority and importance of her



Epidemiologist Dorothy Horstmann, 1956. Her research contributed to the development of the polio vaccine. (National Library of Medicine)

polio research. In the mid-twentieth century, the polio epidemic was causing public panic, especially because the disease primarily attacked children and could cause death or paralysis. Horstmann was a member of the vaccine development committee of the National Institute of Allergy and Infectious Disease, and worked with the World Health Organization in approving a safe version of the oral vaccine.

Horstmann was elected to the National Academy of Sciences in 1975. She was a member of the Infectious Diseases Society of America and served as president of that organization (1974–1975). She was also a fellow of the American Academy of Pediatrics, a master of the American College of Physicians, and an honorary member of the Royal Society of Medicine.

Further Resources

Oshinsky, David M. 2005. "Breaking the Back of Polio." *Yale Medicine*. (Autumn 2005).

Howard (Beckham), Ruth Winifred

1900 1997

Psychologist

Education: B.A., social work, Simmons College, Boston, 1922, M.S., social work, 1927; student, Teachers College and School of Social Work, Columbia University, 1929–1930; Ph.D., psychology and child development, University of Minnesota, 1934

Professional Experience: intern, National Urban League, 1921–1922; social worker, Cleveland Urban League and Cleveland Child Welfare Agency, 1922–1929; intern, Institute of Juvenile Research, University of Illinois, 1935–1936; director, Chicago Mental Health and Training, National Youth Administration, 1937; co-director and clinical psychologist, Center for Psychological Services, 1940–1964; staff psychologist, McKinley Center for Retarded Children, 1964–1966; staff psychologist, Worthington and Hurst Psychological Consultants, 1966–1968; staff, Mental Health Division, Chicago Board of Health, 1968–1972

Concurrent Positions: staff psychologist, Provident Hospital School of Nursing, Chicago, 1940–1964; lecturer and adolescent psychologist, Evanston, Illinois public schools, 1953–1955; University of Chicago's Reading Clinic, 1955–1956

Ruth Howard was one of the first African American women to receive a Ph.D. in psychology and was considered a pioneer for her work on triplets. Howard's research interests included sociology, education, the psychology of race and ethnicity, and developmental psychology. She combined these interests in her groundbreaking doctoral research on the role of both biology (nature) and socialization (nurture) on the development of triplets. She studied more than 200 sets of triplets from different ethnic groups to try to understand why triplets did not perform as well in school as single children. At that time, many psychologists had studied the development of twins, but Howard was among the first to do a large-scale study of triplets. Much of her research was later published in the *Journal of Psychology* (1946) and the *Journal of Genetic Psychology* (1947).

She received her undergraduate and master's degrees in social work and was particularly interested in the educational, economic, and social needs of urban children and families. She was dismayed, however, that the mostly white social workers, her colleagues, viewed the problems of their clients, who were poor and nonwhite, as individual failings with individual solutions, whereas Howard became increasingly aware of the environmental and group psychology and social conditions that impacted the lives of children in such communities. After an early internship with the National Urban League, she received a fellowship to pursue further graduate studies in psychology at Columbia and then went on to the Institute of Child Development at the University of Minnesota, where she worked with several prominent female faculty members, including **Florence Goodenough**. After receiving her Ph.D. in 1934, she married psychologist Albert Beckham and the couple moved to Chicago, where Howard served an internship at the Institute of Juvenile Research at the University of Illinois studying parent-child relations.

Throughout the course of her career, Howard worked at numerous institutions and agencies as a staff or clinical psychologist. During the Depression, she had a temporary position as director of a National Youth Administration job-skills training program in Chicago. In 1940, Howard and Beckham began their own private practice, the Center for Psychological Services, which they directed until 1964 when Albert Beckham died and Ruth Howard retired the practice. Over the course of the 24 years in which they operated the Center, Howard also held staff or consulting positions at numerous institutions, schools, and hospitals. She was on the staff at Providence Hospital School of Nursing in Chicago, a school that trained many black nurses at the time, and consulted for other nursing schools around the country. She also worked with children as a school psychologist, at the University of Chicago's Reading Clinic, where she researched and wrote about play therapy among kindergarteners and fourth-graders, and with developmentally disabled children at the McKinley Center for Retarded Children.

Howard was active professionally as a member of the American Psychological Association, International Psychology Association, International Council of Women Psychologists, International Reading Association, Friends of the Mentally Ill, and American Association of University Women. Her concern with the educational and employment opportunities of black women led to her role in organizing the National Association of College Women in the 1940s.

Further Resources

Guthrie, Robert V. 2004. *Even the Rat Was White: A Historical View of Psychology*. Boston, MA: Allyn and Bacon.

Warren, Wini. 1999. *Black Women Scientists in the United States*. Bloomington: Indiana University Press.

Saltzman, Ann L. 2001. "Ruth Winifred Howard." *The Feminist Psychologist*, Newsletter of the Society for the Psychology of Women, 28(2). <http://www.psych.yorku.ca/femhop/Ruth%20Howard.htm>.

Howes, Ethel Puffer

1872 1950

Psychologist

Education: A.B., Smith College, 1891; University of Berlin and University of Freiburg, 1895–1897; Ph.D., Radcliffe College, 1902

Professional Experience: teacher, Keene High School, New Hampshire, 1891–1892; instructor, mathematics, Smith College, 1892–1895; assistant in psychology, Radcliffe College, 1898–1906; instructor and associate professor, philosophy, Wellesley College, 1901–1906; instructor, psychology, Simmons College, 1904–1906; founder and director, Institute for the Coordination of Women's Interests, Smith College, 1925–1928, lecturer, sociology, 1928–1931

Ethel Puffer Howes was a psychologist whose research interests in the psychology of esthetics and symmetry combined work from several disciplines as well as her interest in women's issues and women's rights. Her career followed the pattern of many women of her generation. After graduating from Smith College, she taught in a high school for one year and then returned to teach mathematics at Smith for three years. She traveled to Germany to study psychology at the University of Berlin and the University of Freiburg, and taught psychology courses at Radcliffe College while completing her doctorate, which she received in 1902. She taught philosophy at Wellesley College for five years, and then psychology at Simmons College. She published a book, *The Psychology of Beauty*, in 1905, but put her psychology career on hold after her marriage in 1908.

Undoubtedly frustrated by her domestic duties with a husband and two children, Howes became active in the woman's suffrage movement, serving as executive secretary of the National College Equal Suffrage League between 1906 and 1915, and publishing numerous articles on women's issues, including balancing career and family, for the *Atlantic Monthly* and other publications. She returned to Smith College as founding director of the Institute for the Coordination of Women's Interests in 1925 with a three-year grant from the Rockefeller Foundation. She then taught sociology courses at Smith for three more years, retiring in 1931.

Howes was a member of the American Association for the Advancement of Science, the American Psychological Association, and the American Philosophical Association.

Further Resources

Scarborough, Elizabeth and Laurel Furumoto. 1987. *Untold Lives: The First Generation of American Women Psychologists*. New York: Columbia University Press.

Hoy, Marjorie Ann (Wolf)

b. 1941

Entomologist, Geneticist

Education: B.A., zoology and entomology, University of Kansas, 1963; M.S., entomology, University of California, Berkeley, 1966, Ph.D., entomology and biological control, 1972

Professional Experience: research geneticist, University of California, Berkeley, 1964–1966; lecturer, biology, Fresno State College, 1967–1968, 1973; laboratory technician, Division of Biological Control, University of California, Berkeley, 1968–1970; research entomologist, Connecticut Agricultural Experiment Station, 1973–1975; research entomologist, Northeast Forest Experiment Station, U.S. Forest Service, 1975–1976; assistant professor to professor, entomological science, University of California, Berkeley, 1976–1992; professor, Biological Control, Department of Entomology and Nematology, University of Florida, Gainesville, 1992–

Marjorie Hoy pioneered the development of an integrated pest management (IPM) program for spider mites in crop plants. The traditional methods for artificial pest control have been pesticide chemicals, breeding of pest-resistant plants, and using natural predators to control the pests. Each method has its drawbacks, but integrated pest management incorporates all three approaches and seeks control rather than eradication. IPM plans emphasize biological controls over chemical controls and use genetics to improve both the pest resistance of the crop plants and the predatory efficiency or survival rate of the pest's predators. Hoy's research team monitored the mite population in California's almond orchards relative to its prey, as well as its levels of pesticide resistance. Resistant species of mites lasted through the winter and retained their pesticide resistance for as long as three or four years. The control program has also been implemented for apples, peaches, and grapes, and it is standard procedure for many other crop plants.

Hoy has received the Bussart Memorial Award (1986) and the Founder's Memorial Award of the Entomological Society of America (1992). She is the editor or co-editor of several books: *Genetics in Relation to Insect Management* (1979), *Recent Advances in Knowledge of the Phytoseiida* (1982), *Biological Control of Pests by Mites* (1983), *Biological Control of Agricultural IPM Systems* (1985), and *Insect Molecular Genetics* (1994). She is a fellow of the American Association for the Advancement of Science and a member of the Entomological Society of America and International Organization for Biological Control of Noxious Animals and Plants.

Further Resources

University of Florida, Gainesville. Faculty website. <http://www.entnemdept.ufl.edu/hoy.htm>.

Hrdy, Sarah C. (Blaffer)

b. 1946

Evolutionary Biologist, Primatologist

Education: B.A., Radcliffe College, 1969; Ph.D., behavioral biology, Harvard University, 1975

Professional Experience: instructor, anthropology, University of Massachusetts, Boston, 1973; lecturer, biological anthropology, Harvard University, 1975–1976, postdoctoral fellow, biology, 1977–1978; senior fellow, American Institute of Indian Studies, New Delhi, India, 1980–1981; visiting associate professor, anthropology, Rice University, 1981–1982; professor, anthropology, University of California, Davis, 1984–1996, emeritus

Concurrent Positions: volunteer teacher's assistant, Harvard Yard Day Care Center, Cambridge, Massachusetts, 1978–1981; associate, Peabody Museum, 1979–; visiting professor, Workshop in Evolutionary Ecology, University of Western Australia, Perth, 2001

Sarah Blaffer Hrdy is renowned for her research on evolutionary biology. As a graduate student at Harvard in 1974, she proposed the controversial theory that infanticide is an adaptive evolutionary strategy among some primate species. After she heard Paul Ehrlich lecture about the dangers of overpopulation, she decided to study the monkeys called Hanuman langurs, of which there are dense populations in parts of India. Her original theory was that overpopulation prompted the langur males to kill a rival's offspring, but she found that whenever a male became

dominant in a group, he would kill his predecessor's offspring so he could breed with the mothers. The next dominant male followed the same pattern. Before the 1970s, most researchers viewed animal societies as smoothly running systems in which each member fulfilled his or her role in the group, and it was thought that primate societies in particular were utopias that humans would do well to emulate. Hrdy's theory was the subject of great controversy, but by the 1980s, anthropologists began to accept the view that infanticide was normal behavior in primates as well as other creatures. Among humans, the practice of preferring male offspring to female can be found in both primitive tribes and modern cultures.

In her book, *The Woman That Never Evolved* (1981), Hrdy contradicted the theory that women are evolutionarily selected to be weaker than men. She argued that the size differential between men and women has only been used to rationalize patriarchy. Her research also examined the evolutionary reasons for women to live 40 or more years past menopause, or childbearing capabilities, and came to the conclusion that older women were evolutionarily important as food-gatherers while younger women were busy bearing and nurturing children. This also-controversial theory contradicted the view that the human family revolves around the males' ability to provide for mothers and children. Hrdy has published several other books, namely, *Black Man of Zinacantan: A Central American Legend* (1972), *Langurs of Abu: Female and Male Strategies of Reproduction* (1980), *Human Ethology* (1989), and *The Evolution of Sex* (1990). Her book *Mother Nature: A History of Mothers, Infants and Natural Selection* (1999) won several literary awards and has been translated into 10 languages. Since her retirement from teaching in 1996, she has remained active as an author, editor, visiting professor, and speaker at international conferences, and has been called upon as an advisor for documentaries on evolution.

Hrdy was elected to membership in the National Academy of Sciences in 1990. Her numerous awards include, most recently, the Howells Prize of the American Anthropological Association (2001) and the Centennial Medal of the Harvard Graduate School of Arts and Sciences (2007). She is a fellow of the Animal Behavior Society and of the American Academy of Arts and Sciences, and a member of the American Society of Naturalists, American Society of Primatologists, American Anthropological Association, and International Primatological Society. She has served on the Committee on Human Rights of the National Academy of Sciences (2001–2004).

Further Resources

Dowling, Claudia Glenn. 2003. "The Hardy Sarah Blaffer Hrdy." *Discover Magazine*. (1 March 2003). <http://discovermagazine.com/2003/mar/feathrdy/>.

"Sarah B. Hrdy, Anthropologist." <http://www.citrona.com/hrdy/index.html>.

Huang, Alice Shih-Hou

b. 1939

Microbiologist

Education: student, Wellesley College, 1957–1959; B.A., Johns Hopkins University, 1961, M.A., 1963, Ph.D., microbiology, 1966

Professional Experience: assistant professor, zoology, National Taiwan University, 1966; postdoctoral fellow, Salk Institute of Biological Science, 1967; postdoctoral fellow, biology, Massachusetts Institute of Technology, 1968–1969; assistant professor to professor, microbiology and molecular genetics, Harvard Medical School, 1971–1991; Dean of Science, New York University (NYU), 1991–1997; Senior Councilor for External Relations and Faculty Associate in Biology, California Institute of Technology, 1997–; consultant, Baltimore Associates

Concurrent Positions: director, Laboratory of Infectious Diseases, Children's Hospital Medical Center, Boston, 1979–1989

Alice Huang led a major breakthrough in understanding how viruses function with the discovery of reverse transcriptase, an enzyme that allows viruses to convert their genetic material into deoxyribonucleic acid (DNA). In searching for clues on how to prevent viruses from replicating, she isolated a rabies type of virus that produced mutant strains that interfered with viral growth. She conducted research with her husband, David Baltimore, at the Massachusetts Institute of Technology, work that led to Baltimore's research on tumor viruses and the discovery of the enzyme called *reverse transcriptase*, which earned Baltimore and his colleague, Howard Temin, the Nobel Prize in Physiology or Medicine in 1975.

Huang was born in China, where her father was a bishop in the Anglican Episcopal Ministry, but when China was taken over by the communists in 1949, her parents sent their four children to the United States for better opportunities and education. While in medical school at Johns Hopkins University, she decided to pursue research rather than become a physician. She went on to teach at Harvard until 1991, when she was appointed dean of science at New York University. She left NYU in 1997 for an affiliation with the California Institute of Technology (CalTech), where her husband was president for 10 years.

Huang has received several honorary degrees and awards, including the Eli Lilly Award in Microbiology and Immunology (1977) and the Alice C. Evans Award (2001), both of the American Society for Microbiology. She also served as president of the American Society for Microbiology in 1988, the first Asian

American to head a national scientific society in the United States. She is a fellow of the Infectious Diseases Society of America and a member of the American Association for the Advancement of Science (president, 2010–2011), American Society for Biochemistry and Molecular Biology, and New York Academy of Sciences. She and her husband have established the consulting firm Baltimore Associates, which specializes in the “establishment of new research institutions and start-up of biotechnology firms” and advising on science policy issues.

Further Resources

Baltimore Associates. <http://www.baltimoreassociates.com>.

Hubbard, Ruth (Hoffman)

b. 1924

Biologist, Biochemist

Education: B.A., science, Radcliffe College, 1944, Ph.D., biology, 1950

Professional Experience: U.S. Public Health Service predoctoral fellow, University College Hospital Medical School, London, 1948; research fellow, biology, Harvard University, 1950–1958, research associate and lecturer, 1959–1973, professor, 1973–1990, emerita

Concurrent Positions: member, Marine Biological Laboratory, Woods Hole, Massachusetts, 1971–

Ruth Hubbard is best known for her research on the biochemistry and photochemistry of vision in vertebrates and invertebrates. She also examined the ethics of gene therapy and genetic testing. After receiving her doctorate, she worked in George Wald's laboratory at Harvard investigating vision. She specifically studied the architecture of visual pigments such as rhodopsin, a molecule that responds to light. The team discovered that light changes the shape of visual pigments that, in turn, initiate all the changes that lead to electrical charges and ultimately to neurotransmission, work for which Wald (whom she married) received the Nobel Prize in Physiology or Medicine in 1967.

When she was asked to give a talk on women scientists to the American Association for the Advancement of Science, Hubbard began questioning the position of women in academia and research. Her interviews with women scientists beginning in the 1970s revealed similar experiences in that none of them had secure or high-level jobs, most having been relegated to positions as research associates,

lecturers, or lab assistants. She joined a group at Harvard that petitioned the university to examine the status of women, and as a result, in 1973, she became the first woman to receive tenure in the sciences at Harvard. After that, she added courses on health and women's issues to her continuing courses on photochemistry. After receiving tenure, she was asked by a reporter if she thought she had received tenure because she was a woman. She replied that the reason she had not received tenure earlier was that she was a woman.

Hubbard wrote and edited a number of books that reflected her interest in sex, gender, and women's health, including *Genes and Gender II: Pitfalls in Research on Sex and Gender* (1979), *Biological Woman: The Convenient Myth* (1982), *Woman's*

Nature: Rationalizations of Inequality (1983), *The Shape of Red: Insider/Outsider Reflections* (1988), *Women Look at Biology Looking at Women* (1989), *The Politics of Women's Biology* (1990), and *Profitable Promises: Essays on Women, Science, and Health* (1994). As a scientist and a feminist, Hubbard was concerned that society oversimplifies science and has had a tendency to explain every trait and behavior through genetics. In *Exploding the Gene Myth* (1993), which she co-authored with her son, Elijah Wald, Hubbard argued that searching to identify all genes, including those for diseases, presents ethical and social dilemmas. She warned of insurers who deny medical coverage because of genetic conditions and argued that finding a gene for breast cancer, for example, may obscure other potential causes of cancers, such as environment.

In addition to her numerous honorary degrees, Hubbard received the Paul Karrer Medal (1967; jointly with George Wald) and awards from the Women's International League for Peace and Freedom (1985) for her advocacy of women's issues and the American Institute of Biological Sciences (1992) for her work on animal vision. She is a member of the American Association for the Advancement of Science, American Society of Biological Chemists, Biophysical Society, and Society of General Physiologists.



Sociobiologist Ruth Hubbard was one of the first women to hold a tenured professorship in the sciences at Harvard University. (National Library of Medicine)

Hughes-Schrader, Sally (Peris)

1895–1984

Zoologist

Education: B.S., Grinnell College, 1917; M.A., protozoology, Columbia University, 1922, Ph.D., zoology, 1924

Professional Experience: instructor, zoology, Grinnell College, 1917–1919; lecturer, Barnard College, Columbia University, 1919–1921; demonstrator, biology, Bryn Mawr College, 1922–1924, instructor, 1924–1930; professor, Sarah Lawrence College, 1931–1941; professor, zoology, Columbia University, 1941–1947, research associate, cytology, department of zoology, 1947–1958; research associate, cytology, Duke University, 1959–1972

Concurrent Positions: independent investigator, Marine Biological Laboratory, Woods Hole, Massachusetts, 1925–; fellow, zoology, Duke University, 1961–1962, visiting professor, 1962–1966

Sally Hughes-Schrader's earlier research concentrated on insects, but her interest shifted in the 1940s to fishes and amphibians, specifically the cranial nerves, cell developments, and parthenogenesis (asexual reproduction) of amphibians and insects. She made innovations in the staining techniques used in cytology. In 1920, she married fellow cytologist and renowned geneticist Franz Schrader, and they were considered one of the notable couples working in science prior to 1940. After receiving her undergraduate degree, she taught at Grinnell College for three years before going to Barnard and Bryn Mawr for teaching and research while she completed her doctorate at Columbia under the direction of well-known cytologist Edmund Beecher Wilson. She was a member of the science faculty at Sarah Lawrence for 11 years and at Columbia for 18 years, where she was also head of the Biology Department at Barnard, the women's college affiliated with Columbia. She moved to Duke University in 1959 as a research associate in cytology. Between 1962 and 1966, she also held a visiting professorship at Duke. During the summers of 1914 and 1920, she had conducted research at the U.S. Department of Agriculture and the Bureau of Fisheries, respectively. She also maintained an affiliation and later lifetime membership with the Marine Biological Laboratory at Woods Hole, Massachusetts, as a summer student and then as an Independent Investigator beginning in 1925.

Hughes-Schrader was active professionally, serving on the editorial boards of the journals *Chromosomes* and *Biological Bulletin*, and as a member of several professional societies, including the American Society of Zoologists, the Genetics

Society of America, the Society for the Study of Evolution, and the American Academy of Arts and Sciences.

Further Resources

Allen, Garland E. 1999. "Edmund Beecher Wilson Letters at the Marine Biological Laboratory." *Mendel Newsletter*. 8:16–19. (February 1999).

"Sally Hughes Schrader." Women of Science, Marine Biological Laboratory. http://www.mbl.edu/publications/women_schrader.html.

Hutchins, Sandra Elaine

b. 1946

Computer Scientist, Communications Engineer

Education: B.A., University of California, San Diego, 1967, Ph.D., information and computer science, 1970

Professional Experience: assistant professor, electrical engineering, Purdue University, 1970–1972; senior staff engineer, communications, TRW Defense & Space Systems, 1972–1977; senior scientist, communications, and engineering manager, Linkabit Corporation, 1977–1979; technical director, voice processing, ITT Defense Communications Division, 1981–1982; Chief Technical Officer, Natural Speech Technologies, 1983–2001; manager, Bloomberg LP, New York, 2001–

Concurrent Positions: instructor, Loyola Marymount University, 1973–1974; instructor, University of California, Davis, Extension, 1978–

Sandra Hutchins is known for her expertise in voice processing in computer software and hardware. She has an undergraduate degree in physics with a minor in linguistics, and a Ph.D. in computer science; her research combines these interests and includes communications, information theory, and signal processing. After teaching for two years in the Electrical Engineering Department of Purdue University, she worked in computer software and hardware design for a number of corporations. She has specialized in design and management of real-time software and hardware for communications, specifically voice processing, message switching, secure computing, modems, and personal computers. She was a senior staff engineer in communications for five years with TRW Defense & Space Systems and technical director of voice processing at ITT Defense Communications Division. She served as engineering manager for two different corporations—Linkabit

Corporation and ITT. She holds at least two patents, one for digital compression of speech and one for computer recognition of speech in severe noise environments.

As CTO of Natural Speech Technologies, a software and systems design consulting firm, she oversaw a line of educational programs, games, puzzles, and software for home management. Several were chosen for a 1985 Smithsonian Institution exhibit on American games, and the company advertises its ability to create user-oriented programs for any computer in any language. Hutchins's primary interest is in programs that enable computers to respond to human speech and to natural English, and which enable users to bypass the keyboard. There are numerous business applications for this software; for example, in the healthcare industry, physicians could dictate directly to the computer the patient diagnosis, indicate the prescriptions or tests needed, and forward the file to the billing department.

Hutchins is a member of the Institute of Electrical and Electronics Engineers and of the Association for Computing Machinery.

Hwang, Jennie S.

Materials Scientist, Engineer

Education: B.S., chemistry, National ChengKung University, 1969; M.S., Liquid Crystal Institute, Kent State University, 1971; M.A., chemistry, Columbia University, 1973; Ph.D., materials science and engineering, Case Western Reserve University, 1976

Professional Experience: research and technology director, chemicals, Lockheed Martin, 1976–1980; exploratory research and business development leader, Sherwin Williams Company, 1980–1982; research director, chemicals, Hanson PLC (SCM Corp.), 1982–1990; co-founder and CEO, International Electronic Materials Corp., 1990–1995; co-founder and CEO, H-Technologies Group, 1995–

Concurrent Positions: columnist and advisory board member, *Surface Mount Technology Magazine*, PennWell Publications, 1991–; distinguished adjunct professor, engineering, Case Western Reserve University, 1996–; interim CEO, Asahi America, Inc., 2002–2009; columnist, *Global Solar Technology Magazine*, UK, 2008–

Jennie Hwang is a materials scientist, engineer, and businesswoman who consults internationally on green technologies, renewable energies, and lead-free electronics. She has successfully navigated a career across business, industry, government, and academia. She has published widely on environmentally friendly electronics

and surface-mount technology, which is used in the creation of circuit boards for consumer, industrial, computer, telecommunication, automotive, aerospace, military and medical industries. She has served on the board of Fortune 500 companies and numerous committees and advisory boards, including for the National Institute of Standards and Technology, National Research Council, and U.S. Department of Commerce, and on cost analysis of electronic weapons for the U.S. Department of Defense. She has served on the advisory boards of numerous international corporations and the Singapore Advanced Technology Institute, as well as of Kent State University and Case Western Reserve University, where she received her doctorate. As an inventor, author, and entrepreneur, she has also been a consultant and invited lecturer for worldwide electronics companies and organizations on business issues, trends, management, and women's leadership and career advancement, as well as on technology education and innovation.

Hwang began her career in technology and chemicals research and management for companies such as Lockheed Martin, Sherwin Williams, and Hanson PLC. In 1990, she co-founded International Electronic Materials Corporation, an electronics manufacturing company. After the company was acquired, she co-founded a global manufacturing and consulting firm, H-Technologies Group, which focuses on intellectual property issues, global market analysis, technology forecast, and providing materials in compliance with international hazardous materials goals and legislation. She has also been the interim CEO of Asahi America, Inc. Additionally, she has been an invited distinguished adjunct professor at the Engineering School of Case Western Reserve University, and has served on the University's Board of Trustees since 1996. She holds numerous patents and has published hundreds of papers, articles, and books.

Hwang was elected to the National Academy of Engineering in 1998. In addition to her numerous civic and business affiliations, she has been a member of the American Chemical Society, American Ceramic Society, and American Society of Metals (Materials Information Society), and she was the first female president of the Surface Mount Technology Association (1994). She has been the recipient of numerous awards and honors, including U.S. Congressional Certificates of Recognition and Achievement (1998 and 2000), Ohio Senate Resolutions for special achievements (1999, 2001, and 2003), induction into the Women in Technology International (WITI) Hall of Fame (2000), a Surface Mount Technology Association (SMTA) Founder's Award (2001), and an honorary doctorate from Ohio University (2007). Dr. Hwang's commitment to science and technology education includes the endowment of a YWCA-Cleveland Award for women science and engineering students, and the Jennie S. Hwang Award for Faculty Excellence at Cleveland State University.

Further Resources

“Jennie S. Hwang, Ph.D., D.Sc.” <http://www.jenniehwang.com/>.

Chung, Deborah D. L. 2006. *The Road to Scientific Success: Inspiring Life Stories of Prominent Researchers*. Hackensack, NJ and Singapore: World Scientific Publishing Company.

Hyde, Ida Henrietta

1857 1945

Physiologist

Education: University of Illinois, 1881; A.B., Cornell University, 1891; Bryn Mawr College, 1891–1893; University of Strasbourg, 1893; Collegiate Alumnae European fellow, 1894–1895; Ph.D., University of Heidelberg, 1896; Naples Zoological Station, 1896; University of Berne, 1896; Radcliffe College, 1897; Harvard Medical School, 1897; University of Liverpool, 1904; M.D., Rush Medical College, 1911

Professional Experience: teacher, public schools, 1881–1888; assistant, biology, Bryn Mawr College, 1891; teacher, histology and anatomy, prep school, 1897–1900; associate professor, physiology, University of Kansas, 1899–1905, professor, 1905–1925

Ida Hyde was the first woman to be elected a member of the American Physiological Society (1902). Her major contribution to physiology was the development of the microelectrode, but it has never been acknowledged officially as hers. After teaching public school for several years, she enrolled at the University of Illinois at the age of 24. She went on to Bryn Mawr College for further study, then went to Germany, where she received a doctorate from the University of Heidelberg in 1896, the first woman to receive a doctorate from that institution. She conducted research at several other universities and institutions, and taught at a college preparatory school before accepting a position as an associate professor of physiology at the University of Kansas in 1899. After the university established a separate department of physiology in 1905, she was promoted to full professor. Later, she attended Rush Medical College for several summers and received an M.D. in 1911.

Hyde had an outstanding reputation as a teacher, and she published two textbooks: *Outlines of Experimental Physiology* (1905) and *Laboratory Outlines of Physiology* (1910). She also worked to promote equal opportunities in science for women. She was instrumental in establishing the Naples Table Association

for Promoting Scientific Research by Women, an organization formed to provide fellowships for American women scientists to the prestigious Naples Zoological Station. She endowed scholarships for women students of science at the University of Kansas and at Cornell University. In 1945, she established the Ida H. Hyde Woman's International Fellowship of the American Association of University Women. She was a member of the American Physiological Society and the American Eugenics Society.

Hyman, Libbie Henrietta

1888 1969

Zoologist

Education: B.S., University of Chicago, 1910, Ph.D., zoology, 1915

Professional Experience: assistant to associate in zoology, University of Chicago, 1910–1931; research associate, American Museum of Natural History, 1937–1969

Libbie Hyman was a zoologist and is best known for her multivolume work *The Invertebrates* (1940–1967). After receiving her doctorate from the University of Chicago, she had a position there as a researcher in zoology until 1931, when the department head retired. She was unable to secure another university position, whether because she was Jewish or because it was extremely difficult for women scientists to find employment during the Depression years. While employed at Chicago, she published several studies: *A Laboratory Manual for Elementary Zoology* (1919, 1926) and *A Laboratory Manual for Comparative Vertebrate Anatomy* (1922). Later, she wrote *Comparative Vertebrate Anatomy* (1942). Starting in 1937, the American Museum of Natural History provided Hyman with an office, laboratory use, and library privileges, but no salary. It was under this arrangement that she prepared the six volumes of *The Invertebrates*, primarily supporting herself from the sales of her earlier books.

Hyman received many awards, including the Elliot Gold Medal of the National Academy of Sciences (1954) and an award from the Linnean Society of London (1960). She was elected to membership in the National Academy of Sciences in 1961. She received honorary degrees from several colleges and was president of the Society of Systematic Zoology from 1959 to 1963. She was also a member of the American Society of Zoologists, the American Society of Naturalists, and the American Society of Limnology and Oceanography.

Intriligator, Devrie (Shapiro)

b. 1941

Astrophysicist

Education: B.S., physics, Massachusetts Institute of Technology, 1962, M.S., 1964; Ph.D., planetary and space physics, University of California, Los Angeles, 1967

Professional Experience: assistant research geophysicist, Institute of Geophysics and Planetary Physics, University of California, Los Angeles (UCLA), 1967; research associate, Space Science Division, Ames Research Center, National Aeronautics and Space Administration (NASA), 1967–1969; research fellow, physics, California Institute of Technology, 1969–1972, assistant professor, 1972–1980, member, Space Science Center, 1978–1983; staff member, Stauffer Hall of Science, University of Southern California, 1974–1977, assistant professor, physics, 1977–1979; senior research physicist, Carmel Research Center, 1979–, director, Space Plasma Laboratory, 1980–

Devrie Intriligator is renowned for her research in space physics and astrophysics, and for her expertise in designing measurement instruments for interplanetary spacecraft. Among the projects in which she has participated are the Pioneer 10 and 11 missions to the outer planets, the Pioneer-Venus Orbiter, and the Pioneer 6, 7, 8, and 9 heliocentric missions. Her research includes high-energy nuclear physics, plasma physics, and astrophysics. She began doing physics experiments as a high school sophomore and won a national prize in a Future Scientist of America contest in her senior year. She received financial aid to enroll in college, but the dean of women at the first school she attended would not permit her to enroll in physics, and she had to give up the financial aid when she transferred to the Massachusetts Institute of Technology (MIT) the following year. She was unable to secure any funding at MIT due to prejudices against women due to the belief that women would not put their education to use and find work as scientists. Instead, Intriligator held a number of jobs in college to support herself. She was a research assistant in the cosmic ray group at MIT in 1960, and prior to her senior year, was a consulting physicist for the Institute of Physics, University of Milan, where she consulted on cosmic-ray balloon experiments. She continued as a

graduate student at MIT and worked as a physicist in the cosmic-ray branch of the Air Force's Cambridge Research Laboratory from 1962 to 1963. When her husband received an appointment to teach at UCLA, she transferred to that school to complete her doctorate.

Since UCLA would not accept her credits from MIT, she had to repeat a number of courses, but in the course of the three years she spent studying at UCLA, she became interested in solar wind plasma physics and decided to add it as a specialty. The solar wind plasma is a stream of particles—electrons, protons, and other ions—that continually flow from the sun and that is responsible for many features of the solar system and the Earth's environment. After graduation, she won a prestigious National Academy of Sciences Resident Research Associateship for use at NASA's Ames Research Center, where she was the principal investigator of the positive-ion probe on the UCLA Small Scientific Satellite. She also was a co-investigator of the Ames solar wind plasma probes on several Pioneer spacecraft in orbit around the sun.

At the California Institute of Technology, where she began working in 1969, she analyzed data sent back from instruments aboard the Pioneer spacecraft in orbit around the sun. She was co-investigator of the Ames solar wind plasma probe for the Pioneer 10 and 11 missions to Jupiter, and she was also a member of the plasma measurement team for the outer planet missions to Jupiter, Saturn, Uranus, Neptune, and Pluto. In her current position as director of the Space Plasma Laboratory, she is continuing her research on cosmic rays and solar winds.

Intriligator is co-editor of the book *Exploration of the Outer Solar System* (1976) and has written numerous scientific papers. She has received three achievement awards from NASA and is a member of the American Geophysical Union, American Physical Society, and American Association for the Advancement of Science.

Irwin, Mary Jane

b. 1949

Computer Scientist

Education: B.S., mathematics, Memphis State University, 1971; M.S., computer science, University of Illinois, Urbana-Champaign, 1975, Ph.D., computer science, 1977

Professional Experience: associate to assistant professor, computer science, Pennsylvania State University, 1977–1989, professor, computer science and

engineering, 1989–1999, Distinguished Professor, 1999–2003, A. Robert Noll Chair in Engineering, 2003–, Evan Pugh Professor, computer science and engineering, 2006–

Concurrent Positions: research staff, Supercomputer Research Center, Institute for Defense Analysis, Maryland, 1986

Mary Jane Irwin is a computer sciences engineer whose research focuses on computer architecture, computer arithmetic, embedded and mobile computing systems design, energy and reliability aware systems design, and emerging technologies in computing systems. She received a Ph.D. in computer science from the University of Illinois and has been a faculty member in computer sciences and engineering at Pennsylvania State University since 1977. She is co-director of the Microsystems Design Lab at Pennsylvania State University, a project funded collaboratively by both government and corporate research interests, including the National Science Foundation, Gigascale Systems Research Center, Semiconductor Research Corporation, Pennsylvania Technology Collaborative, Intel, Microsoft, Honda, and Toyota. She has been an invited lecturer and speaker at conferences and universities worldwide and has served on numerous government, corporate, and academic research councils and advisory committees, including Microsoft's External Research Advisory Board. She was a founding editor of the Association for Computing Machinery's *Journal on Emerging Technologies in Computing Systems*.

Irwin was elected to the National Academy of Engineering in 2003. She is a fellow of the American Academy of Arts and Sciences, Association for Computing Machinery (ACM), and Institute of Electrical and Electronics Engineers (IEEE), and a member of the International Federation for Information Processing. Her awards and honors include an honorary doctorate from Chalmers University, Sweden (1997), Pennsylvania State University Engineering Society's Premier Research Award (2001), IEEE/CAS Best Paper Award (2003), DAC Marie R. Pistilli Women in EDA Award (2004), ACM/SIGDA Distinguished Service Award (2005 and 2007), ACM Distinguished Service Award (2005), Computing Research Association's (CRA) Distinguished Service Award (2006), IEEE/ICPADS Best Paper Award (2006), and Anita Borg Technical Leadership Award (2007).

Further Resources

Pennsylvania State University. Faculty website. <http://www.cse.psu.edu/research/mdl/mji/>.

J

Jackson, Jacquelyne Mary (Johnson)

b. 1932

Sociologist

Education: B.S., University of Wisconsin, Madison, 1953, M.S., 1955; Ph.D., sociology, Ohio State University, 1960

Professional Experience: assistant to associate professor, Southern University, 1959–1962; professor and department chair, sociology, Jackson State College, 1962–1964; assistant professor, Howard University, 1964–1966; instructor, medical sociology, Duke University Medical Center, 1967–1968, assistant to associate professor, 1968–1998, emerita

Concurrent Positions: visiting professor, sociology, St. Augustine's College, 1969–

Jacquelyne Jackson is known for her research on minority aging and for her participation in the civil rights movement. She also had a number of “firsts” in her career. She was the first black woman to receive a doctorate in sociology from Ohio State University, the first full-time black faculty member to be hired at the Duke University Medical Center, and the first black tenured faculty member at the medical school. After receiving her doctorate, she did postdoctoral study at the University of Colorado before becoming a faculty member at Southern University, a professor of sociology at Jackson State College, an assistant professor at Howard University, and then joining the faculty of the Duke University Medical Center as an assistant professor of medical sociology. Her work has always been connected to real people and real issues. Her interest in minority aging grew out of the experience of elderly friends who had to sell their houses to pay for medical care. Later, one friend was in a racially segregated ward in New Orleans's Charity Hospital, and Jackson organized her students to donate “black” blood for the woman because blood was segregated at the time. In 1974, she and colleague Frank Cantor made a short documentary film called *Old, Black and Alive*, which investigated the living conditions and needs of elderly African Americans in one Alabama county. She helped found the *Journal of Minority Aging*, and in 1980, she published *Minorities in Aging*, which has become a classic in the field.

Jackson became involved in the civil rights movement while teaching at Jackson State College. When a group of civil rights advocates was forbidden to hold a meeting at Jackson State for fear of creating racial unrest, she secured the support of Charles Evers, brother of Medgar Evers, to schedule the meeting at another site in the city. She took part in the 1963 march in Washington, D.C., and in 1962, she published *These Rights They Seek*, a study of the Tuskegee Civic Association, the Montgomery Improvement Association, and the Alabama Christian Movement for Human Rights.

Jackson was elected a fellow of the National Science Foundation in 1961. In addition to her teaching and research, she has also served as a consultant to the National Center for Health Statistics and to the U.S. Senate's Special Committee on Aging. She was a member of numerous professional and civic organizations, including but not limited to the Association of Social and Behavioral Scientists, National Council on Family Relations, American Sociological Association, Caucus of Black Sociologists, National Caucus on the Black Aged, Gerontological Society, and Carver Research Foundation of Tuskegee Institute.

Jackson, Shirley Ann

b. 1946

Physicist

Education: B.S., Massachusetts Institute of Technology, 1968, Ph.D., physics, 1973

Professional Experience: research associate, theoretical physics, Fermi National Accelerator Laboratory, 1973–1974; visiting science associate, European Organization for Nuclear Research (CERN), Geneva, 1974–1975; research associate, Stanford Linear Accelerator Center, 1975–1976; technical staff, theoretical physics, AT&T Bell Laboratories, 1976–1991; professor, physics, Rutgers University, 1991–1995; chair, Nuclear Regulatory Commission (NRC), 1995–1999; president, Rensselaer Polytechnic Institute, 1999–

Concurrent Positions: chair, International Nuclear Regulators Association (INRA), 1997–1999.

Shirley Ann Jackson is a theoretical physicist whose research has focused on particle physics and condensed matter physics. Theoretical physics uses theories and mathematics to predict the existence of subatomic particles and the forces that bind them together. One method for this research uses a particle accelerator, a



Physicist Shirley Ann Jackson, President of Rensselaer Polytechnic Institute, with Senator Hillary Rodham Clinton of New York, 2005. (AP/Wide World Photos)

device in which nuclei are accelerated to high speeds and then forced to collide with a target to separate them into subatomic particles. Another method detects their movements using certain types of nonconducting solids. Jackson has conducted research using both methods at a number of prestigious physics laboratories in both the United States and Europe, such as the Fermi National Accelerator Laboratory in Illinois, the European Organization for Nuclear Research in Switzerland, and the Stanford Linear Accelerator Center in California.

Jackson was the first African American woman to receive a doctorate in any field from the Massachusetts Institute of Technology, and she was the first woman and the first African American to serve as chair of the Nuclear Regulatory Commission (NRC), the federal agency that regulates the uses of nuclear materials and technology throughout the United States to ensure the protection of public health, safety, and the environment. At the NRC, she oversaw the process for renewing the licenses of existing nuclear power plants, ensuring public safety as

electric utilities were deregulated, and ensuring safety in the disposal of spent reactor fuel. In 1997, the International Nuclear Regulators Association was formed with Jackson elected as its first chair. She became president of Rensselaer in 1999, the first black woman to lead a major technology institute. Jackson brings to this position her commitment to the presence of more women and minorities in science and technology careers.

In 2001, Jackson was the first African American woman to be elected to the National Academy of Engineering. She has received numerous honorary degrees and awards, including the Thomas Alva Edison Science Award (1993), the New Jersey Governor's Award in Science (1993), the Golden Touch Award for Lifetime Achievement from the National Society of Black Engineers (2000), the Black Engineer of the Year Award from *US Black Engineer & Information Technology* magazine (2001), and the Vannevar Bush Award from the National Science Board (2007). She has been inducted into the National Women's Hall of Fame (1998) and the Women in Technology International (WITI) Hall of Fame (2000), and was a fellow of the Association of Women in Science (2004). She is a member of the American Physical Society, New York Academy of Sciences, National Society of Black Physicists (president, 1980), American Academy of Arts and Sciences, and American Association for the Advancement of Science (president, 2004). In 2002, she was named one of "The 50 Most Important Women in Science" by *Discover* magazine. In 2009, Jackson was appointed to President Obama's Council of Advisors on Science and Technology.

Further Resources

Rensselaer Polytechnic Institute. "Shirley Ann Jackson, Ph.D." <http://www.rpi.edu/president/profile.html>.

Williams, Clarence G. 2003. *Technology and the Dream: Reflections on the Black Experience at MIT, 1941–1999*. Cambridge, MA: MIT Press.

Jameson, Dorothea A.

1920–1998
Psychologist

Education: B.A., Wellesley College, 1942

Professional Experience: research assistant, Harvard University, 1941–1947; research psychologist, color control department, Eastman Kodak Company, 1947–1957; research scientist, psychology, New York University (NYU),

1957–1962; research associate, psychology, University of Pennsylvania, 1962–1968, research professor, 1968–1972, professor, psychology and visual science, 1972–

Concurrent Positions: visiting professor, University of Rochester, 1974–1975; visiting professor, Columbia University, 1974–1976

Dorothea Jameson was an expert in the new field of color vision, and she combined her work in psychology with work in optics, visual mechanisms, and human perception. While still an undergraduate at Wellesley, she worked as a research assistant at Harvard where, during World War II, she worked on improving the accuracy of visual rangefinders. It was at Harvard that she met her future husband, psychologist Leo Hurvich, the beginning of a lifelong professional collaboration. The couple (who married in 1948) worked together as researchers at Eastman Kodak in Rochester, New York, spent five years at NYU, and then moved to the department of psychology and Institute of Neurological Sciences at the University of Pennsylvania. Even without an advanced degree, Jameson was hired based on her experience as a researcher. A bigger problem for her was that, at that time, most universities were opposed to hiring husband-and-wife faculty teams, so Jameson was not appointed a regular faculty position until the rules were loosened in 1968; she was promoted to full professor at the University of Pennsylvania in 1972. Jameson and Hurvich published dozens of scientific papers together and were renowned for their innovations in color vision research. Much of Jameson's early research at NYU and the University of Pennsylvania was supported by grants from the National Institutes of Health (NIH) and the National Science Foundation. She was a fellow of the Center for Advanced Study in Behavioral Sciences in 1981 and 1982, and served on the national advisory eye council for the NIH starting in 1985.

Jameson was elected to membership in the National Academy of Sciences in 1975. Between 1983 and 1986, she was chair of the National Academy of Sciences psychology section. She received honorary degrees from the University of Pennsylvania (1972) and the State University of New York (1989). She was a fellow of the Society of Experimental Psychologists and the American Academy of Arts and Sciences, and a member of the Optical Society of America. Her numerous awards and honors included the Warren Medal of the Society of Experimental Psychologists (1971), the Distinguished Science Contribution Award of the American Psychological Association (1972), the Inter-Society Color Council's Godlove Award for Research in Color Vision (1973), the Wellesley College Alumnae Achievement Award for Scientific Research (1974), the Tillyer Medal of the Optical Society of America (1982), the Judd Award of the Association Internationale de Couleur (1985), and the Helmholtz Award from the Cognitive Neuroscience Association (1987).

Further Resources

University of Pennsylvania. 1998. "Dorothea Jameson, Pioneer in Color Perception." *Almanac*. 44(30). (21 April 1998). <http://www.upenn.edu/almanac/v44/n30/deaths.html>.

Jan, Lily

Neurobiologist

Education: B.Sc., physics, National Taiwan University, 1968; M.Sc., physics, California Institute of Technology, Ph.D., physics and biophysics

Professional Experience: postdoctoral research fellow, California Institute of Technology (CalTech) and Harvard University; Lange Professor of Physiology and Biophysics, University of California, San Francisco (UCSF); Howard Hughes Medical Investigator, 1984–

Lily Jan is a neurobiologist and biophysicist whose research focuses on the development and function of the nervous system and, in particular, how potassium (regulated through "potassium channels") affects the electrical impulses sent from the brain throughout the body. Born in China and raised in Taiwan, Jan chose physics to study in high school due to the inspiration of recent Nobel Prize winners in China. She graduated from National Taiwan University in 1968 and moved to the United States to attend CalTech for graduate work in theoretical physics. She was inspired again by another Nobel Prize winner, Max Delbrück, one of her professors, who encouraged her interest in biology, and she earned her doctorate in physics and biophysics from CalTech. Another Taiwanese student who had come to study at CalTech was Yuh Nung Jan. The two were lab partners and then postdoctoral research fellows together in neurobiology, married in 1971, and began collaborating on projects involving genetic explanations for certain behaviors in the fruit fly. They were the first to identify the DNA sequence responsible for potassium channels and mutations in the channels, linking it to behavioral changes in the fly. The Jans conducted some postdoctoral work in neurophysiology at Harvard and then returned to the West Coast as faculty members at UCSF. They raised two children together and regularly collaborate in the lab, but have also developed their own individual research interests and groups at UCSF and as Howard Hughes Medical Institute investigators.

Jan was elected a member of the National Academy of Sciences in 1995, and is a fellow of the American Academy of Arts and Sciences and Academia Sinica (Taiwan). Her awards and honors include a Javits Neuroscience Investigator

Award, W. Alden Spencer Award from Columbia University, K. S. Cole Award, Distinguished Alumni Award from California Institute of Technology, and Presidential Award of the Society of Chinese Bioscientists in America. She was named Harvard Foundation's 2005 Scientist of the Year.

Further Resources

University of California, San Francisco. "Jan Laboratory." <http://physio.ucsf.edu/jan/index.html>.

Howard Hughes Medical Institute. "Lily Y. Jan, Ph.D." http://www.hhmi.org/research/investigators/janly_bio.html.

"Biophysicists in Profile: Lily Jan." Biophysical Society Newsletter. (September/October 2002). <http://www.biophysics.org/Portals/1/PDFs/Career%20Center/Profiles/jan.pdf>.

Jeanes, Allene Rosalind

1906 1995

Chemist

Education: A.B., Baylor University, 1928; A.M., University of California, Berkeley, 1929; Ph.D., organic chemistry, University of Illinois, 1938

Professional Experience: high school teacher, mathematics and physics, 1930; department head, science, Athens College, Alabama, 1930–1935; instructor, chemistry, University of Illinois, 1936–1937; research fellow, National Institutes of Health, 1938–1940; research chemist, Northern Regional Research Laboratory, U.S. Department of Agriculture (USDA), 1941–1976

Allene Jeanes was an organic chemist whose research group isolated and characterized over 100 different dextrans that have great value in research, especially in immunology and immunochemistry. She received one of the first Corn Industries Research Foundation fellowships at the National Institutes of Health, where she co-developed a new technique of periodate oxidation of starches. She joined the staff at Northern Regional Research Laboratory in Peoria, Illinois, a regional laboratory of the USDA, in 1941, three months after it opened. Initially she studied the nature and structural role of the branch points in starch and developed xanthan gum, a thickening substance used in numerous food and cosmetic products. During the Korean War, there was a need for a blood-plasma substitute, and she and her group were able to find a chemical, dextran, that was used successfully to expand plasma volume. Her technique was used for isolating and characterizing dextrans, and she held several patents for her work.

In 1953, Jeanes was the first woman in the Chemistry Bureau to receive the USDA Distinguished Chemist Award. She was also the recipient of a Garvan Medal of the American Chemical Society (1956) and a Federal Woman's Award of the U.S. Civil Service Commission (1962). In 1999, she was posthumously inducted in the USDA's Agricultural Research Service (ARS) Science Hall of Fame. She was a member of the American Chemical Society.

Jemison, Mae Carol

b. 1956

Physician, Astronaut

Education: B.S., chemical engineering, B.A., African and Afro-American Studies, Stanford University, 1977; M.D., Cornell University Medical School, 1981

Professional Experience: intern, University of Southern California Medical Center, 1981–1982; physician, INA–Ross Loos Medical Group, Los Angeles, 1982; medical officer, Peace Corps, 1983–1985; physician, Cigna Health Plan of California, 1985–1987; astronaut, National Aeronautics and Space Administration (NASA), 1987–1993, mission specialist, *Endeavour*, 1992; founder and director, Jemison Group, 1993–; founder, BioSentient, 1999–

Concurrent Positions: professor-at-large, Cornell University; teaching fellow, environmental studies, Dartmouth College, 1995–2002

Mae Jemison is a physician and astronaut who was the first black woman to travel in space. She began her career as a Peace Corps medical officer in Africa and then as a physician and biomedical researcher investigating hepatitis B vaccine, schistosomiasis, and rabies. She entered astronaut training in 1987 and was assigned to the space shuttle *Endeavour* mission that flew September 12–20, 1992. Aboard the *Endeavour*, she conducted experiments concerning weightlessness, tissue growth, and the development of semiconductor materials. One of the experiments was to test whether motion sickness in space could be alleviated by the use of biofeedback techniques. She also investigated the loss of calcium in human bones in space and the effects of weightlessness on the fertilization and embryologic development of frogs.

While in medical school, Jemison traveled to a Thai refugee camp and received a grant to conduct health studies in Kenya. She joined the Peace Corps and traveled to Sierra Leone and Liberia, where she managed healthcare for volunteers, developed and taught health classes for volunteers, and implemented public health

and safety guidelines for the program. When NASA announced in 1986 that it was seeking candidates for the space shuttle program, she applied and was one of 15 chosen from a field of some 2,000 applicants. After five years in the astronaut program, Jemison left for a teaching and science advocacy career. She has since founded two companies and worked on projects such as establishing a space-based telecommunication system to facilitate healthcare delivery in countries of the developing world, and marketing mobile medical technologies. She also directed the Jemison Institute for Advancing Technology in Developing Countries at Dartmouth College.

Jemison was elected to the Institute of Medicine of the National Academy of Science in 2001. She is a popular public figure and role model committed to inspiring young people, women, and minorities in the sciences. She has appeared in television shows and documentaries, and in 1994, she founded a science camp program for children aged 12 to 16 called “The Earth We Share” (TEWS). She is also the national science spokesperson for the Bayer pharmaceutical and medical research company. Her autobiography, *Find Where the Wind Goes: Moments from My Life*, was published in 2001.

Further Resources

Kevles, Bettyann H. 2003. *Almost Heaven: The Story of Women in Space*. New York: Basic Books.

National Aeronautics and Space Administration “Mae C. Jemison (M.D.).” <http://www.jsc.nasa.gov/Bios/htmlbios/jemison-mc.html>.

“Meet Our National Spokesperson, Mae C. Jemison M.D.” Making Science Make Sense. Bayer US. http://www.bayerus.com/msms/MSMS_About/NationalSpokesperson/Spokesperson.aspx.

Johnson, Barbara Crawford

b. 1925

Aerospace Engineer

Education: B.S., general engineering, University of Illinois, 1946

Professional Experience: engineer, Rockwell International Space Division, 1950s, project leader and supervisor, Entry Performance Analysis, 1961–1968, system engineer and manager, Apollo program, 1968–1972, manager, Mission Requirements and Integration, Rockwell Space Systems Group, 1973–1983

Barbara Johnson is one of the many women scientists and engineers who have played significant supplementary roles in the National Aeronautics and Space

Administration (NASA) space program. She spent her career at the Rockwell International Space Division in support of the manned space flight program. Rockwell was one of the primary contractors for NASA, and one of Johnson's major contributions was to create the Entry Monitor System (EMS), the backup entry guidance system designed for the Apollo space missions. The EMS is a graphic display for the astronauts to use in the case of a primary guidance failure, and similar graphic displays are now a part of the instrument panels of virtually all spacecraft and aircraft, and are even currently available in many automobiles. She was supervisor of the Entry Performance Analysis team, which determined the trajectories that enabled the Apollo aircraft to reenter the Earth's atmosphere safely; if it entered on too shallow a trajectory, there was a danger of overheating; if too deep, the astronauts would experience unbearable gravitational forces. Before the 1960s, a spacecraft had never reentered the Earth's atmosphere from hypervelocity, which is a speed greater than that of the Earth's rotation. As system engineering manager for the Apollo program, she supervised system analysis in support of a lunar landing and exploration. In 1973, she was named manager of Mission Requirements and Integration for Rockwell, which meant she directed the mission, flight performance, and trajectory design analysis of the space shuttle and orbiter projects.

Johnson received a medallion from NASA for her role in the first Apollo landing on the moon, and she has also received the Achievement Award of the Society of Women Engineers (1974), the Distinguished Alumni Merit Award from the University of Illinois (1975), and the Outstanding Engineer Merit Award of the Institute for the Advancement of Engineers (1976). She is a member of the American Institute of Aeronautics and Astronautics, and a fellow of the Institute for the Advancement of Engineers.

Further Resources

Society of Women Engineers. "Barbara Crawford Johnson." http://societyofwomenengineers.swe.org/index.php?option=com_content&task=view&id=46&Itemid=68.

Johnson (Masters), Virginia (Eshelman)

b. 1925

Psychologist, Sex Therapist

Education: student, Drury College, 1940–1942, University of Missouri, 1944–1947; student, Washington University, St. Louis

Professional Experience: research staff, Division of Reproductive Biology, School of Medicine, Washington University, St. Louis, 1957–1960, research assistant and instructor, 1960–1964; research associate, Reproductive Biology Research Foundation, St. Louis, 1964–1969, assistant director to co-director, 1969–1973; co-director, Masters and Johnson Institute, 1973–1994; director, Virginia Johnson Masters Learning Center, St. Louis, 1994–



Psychologist and sex therapist Virginia Johnson and physician William H. Masters were known for their pioneering studies of human sexuality. (AP/Wide World Photos)

Virginia Johnson is renowned for her pioneer studies with William H. Masters and her unique contribution to our knowledge of human sexuality. At the Reproductive Biology Research Foundation in St. Louis, and later at the Masters and Johnson Institute, she counseled clients and taught sex therapy to practitioners. By the late 1950s, William Masters was a respected professor of obstetrics and gynecology who hired Virginia Johnson to interview volunteers for his research project on reproductive biology. Soon she was promoted to research assistant, instructor, and eventually co-director of the project. Gathering scientific data by electroencephalography (EEG), electrocardiography, and the use of color monitors, the two measured and analyzed 694 volunteers. They gathered data allowing them to identify the four stages of sexual arousal, the efficacy of contraceptives, and the observation that sexual enjoyment need not decrease with age. They created the nonprofit Reproductive Biology Research Foundation in 1964, began training couples to combat their sexual problems, and wrote a scientific text, *Human Sexual Response* (1966), describing their research. Although the book was advertised only in scientific journals, within a few months, it had become a bestseller.

Masters and Johnson married in 1971, founded the Masters and Johnson Institute in 1973, and went on to publish several books for a general audience, always inciting controversial reactions to their findings on sensitive topics. In *Human Sexual Inadequacy* (1970), they discussed the possibility that sex problems are more cultural than physiological or psychological. *The Pleasure Bond: A New Look at Sexuality and Commitment* (1975) advised total commitment and fidelity to the partner as the basis for an enduring sexual bond. In *Homosexuality in Perspective* (1981),

they came to the controversial conclusion that homosexuality is a “learned” behavior and that homosexuals can be “converted.” In *Crisis: Heterosexual Behavior in the Age of AIDS* (1988; co-authored with Dr. Robert Kolodny), they accurately predicted a large-scale outbreak of the virus in the heterosexual community. However, due to exaggerated and erroneous claims about how AIDS could be transmitted, many in the medical community, including the surgeon general C. Everett Koop, criticized the study, and the negative publicity hurt the couple’s reputation. They divorced in 1992, and the Institute was closed in 1994 with Masters’s retirement. Johnson, however, retained the Institute’s records and went on to found the Virginia Johnson Masters Learning Center in St. Louis, which produces instructional material for couples with sexual problems. William H. Masters died in 2001.

Further Resources

Maier, Thomas. 2009. *Masters of Sex: The Life and Times of William Masters and Virginia Johnson, the Couple Who Taught America How to Love*. New York: Basic Books.

Johnston, Mary Helen

b. 1945

Metallurgical Engineer

Education: B.S., engineering science, Florida State University, 1966, M.S., 1969; Ph.D., metallurgical engineering, University of Florida, 1973

Professional Experience: metallurgical staff, University of Alabama, Huntsville, 1969–; materials engineer, George Marshall Space Flight Center, National Aeronautics and Space Administration (NASA), 1969–1983, payload specialist, astronaut program, 1983–1985

Mary Johnston is known for her expertise in failure analysis while working at the George Marshall Space Flight Center of NASA. As a metallurgist, she was concerned with the stability of the metal and materials parts of which the spacecraft was composed. There always is a possibility that a part might malfunction or break when exposed to the extremes of soaring heat or frigid cold in space, and the failure could occur in any part of a spacecraft, including bolts and screws. Although she worked for NASA for a number of years, she was never part of the astronaut program. In the 1970s, she started planning for the time when women would be accepted into the space program, and she was among the women employees who taught themselves how to function in a weightless environment. When she chose her major of metallurgical engineering, materials processing in space did not exist

as a specialty. However, in 1974, she participated in an all-woman crew of experimenters in a five-day simulation of a Spacelab mission set up by NASA at Marshall because NASA needed to know how difficult it would be to handle materials-processing experiments in space. These experiments required a lot of power and put out a lot of heat, and Johnston predicted that nuclear radiation detector material would be a good material for a Spacelab experiment. One advantage of metallurgical research in space is that the zero-gravity environment in space allows for more control; on Earth, it is more difficult to study the processes involved in metals when the metals are cooled. Later, she was assigned to be the backup payload specialist on Spacelab 3, but she did not go into space.

Johnston was the first woman to graduate from Florida State University in engineering, and went on to graduate school at the University of Florida, one of the few female engineering students who completed that program. She is a member of American Society for Metals and National Society of Professional Engineers.

Jones, Anita Katherine

b. 1942

Computer Scientist

Education: B.A., mathematics, Rice University, 1964; M.A., English, University of Texas, Austin, 1966; Ph.D., computer science, Carnegie Mellon University, 1973

Professional Experience: programmer, International Business Machines Corporation (IBM), 1966–1968; assistant to associate professor, computer science, Carnegie Mellon University, 1973–1981; vice president and founder, Tartan Laboratories, Pittsburgh, 1981–1987; freelance consultant, 1987–1988; professor and department chair, computer science, University of Virginia, 1988–1993; director, Defense Research and Engineering, U.S. Department of Defense, 1993–1997; professor, computer science, University of Virginia, 1997–

Anita Jones is renowned for her work in the area of computer software and systems. Her research includes design and implementation of programmed systems on computers, including enforcement of security policies on computers, operating systems, and scientific databases. She was director of Defense Research and Engineering for the U.S. Department of Defense (DOD) (the highest-level defense job ever held by a woman), the department's senior official for research and technology matters. Her responsibilities included management of DOD science and technology programs; all in-house laboratories and research, development, and engineering centers; university research initiatives; and overseeing the

Advanced Research Projects Agency, which was responsible for the development of ARPAnet, the predecessor of the Internet. The DOD engineering research would eventually serve as a basis for both commercial and military information technology. Early on, Jones predicted that virtual reality (VR) simulations would be used extensively in education and job training, pointing out that the military invented high-fidelity simulations for flight training, and it still bankrolls the most cutting-edge applications.

Jones is married to fellow University of Virginia computer science professor William Wulf, who served a 10-year term as president of the National Academy of Engineering. Together they have formed a formidable power couple of engineering. In 1981, they launched a software firm, Tartan Laboratories, which specialized in research for optimizing compilers. Six years later, they sold the company to Texas Instruments and accepted faculty positions at the University of Virginia. Jones took a leave from her academic position to work for the DOD, but returned to academia in 1997. She has edited two books—*Foundations of Secure Computation* (1971) and *Perspectives in Computer Science* (1977)—in addition to writing numerous scientific papers. She has been a consultant to or member of the National Research Council, the Defense Science Board (1985–1993), and the U.S. Air Force Science Advisory Board (1980–1985), and served as vice chair of the National Science Foundation (2000–2006).

Jones was elected to membership in the National Academy of Engineering in 1994. She is a fellow of the Association for Computing Machinery and the Institute of Electrical and Electronics Engineers. She is the recipient of an Air Force Meritorious Civilian Service Award (1985) and a Distinguished Service Award of the Computing Research Association (1997).

Further Resources

Schrof, Joannie M. “Keeping Up with Anita Jones.” http://www.cs.virginia.edu/misc/news-jones-keeping_up.html.

University of Virginia. Faculty website. <http://www.cs.virginia.edu/brochure/profs/jones.html>.

Jones, Mary Ellen

1922–1996

Biochemist

Education: B.S., biochemistry, University of Chicago, 1944; Ph.D., biochemistry, Yale University, 1951

Professional Experience: research chemist, Armour and Company, 1942–1948; U.S. Public Health Service Fellow, physiological chemistry, Yale University, 1950–1951; postdoctoral fellow, biochemistry research laboratory, Massachusetts General Hospital, 1951–1957; assistant to associate professor, biochemistry, Brandeis University, 1957–1966; associate professor to professor, biochemistry and zoology, University of North Carolina, Chapel Hill, 1966–1971; professor, biochemistry, University of Southern California, 1971–1978; professor, biochemistry and nutrition, University of North Carolina, Chapel Hill, 1978–1995

Mary Ellen Jones was a distinguished biochemist who contributed to early cancer research through her studies of DNA and RNA. Her research interests included biosynthetic and transfer reactions, metabolic regulation of enzymes, multifunctional proteins, and pyrimidine and amino acid biosynthesis. Her studies of metabolic pathways increased understanding of how cells, including cancer cells, divide and differentiate. This laid the groundwork for later, continued cancer research studies. She worked as a research chemist for Armour and Company while obtaining her undergraduate degree from the University of Chicago. She continued her education at Yale, where her husband Paul Munson was a faculty member in pharmacology, and received her doctorate in 1951 under a prestigious U.S. Public Health Service fellowship. She held a postdoctoral fellowship at Massachusetts General Hospital under Fritz Lipmann, who went on to win the Nobel Prize in Physiology or Medicine in 1953. She worked at Brandeis University as a biochemist until 1966, when the couple both moved to the University of North Carolina, Chapel Hill (UNCCH). Jones became a full professor at UNCCH in 1968, but moved to the University of Southern California in 1971. She returned to her position at UNCCH in 1978, where she was the first woman to head a medical school department at that institution. Jones was associate editor of the *Canadian Journal of Biochemistry* from 1969 to 1974. She was co-editor of a book, *Purine and Pyrimidine Nucleotide Metabolism* (1978), which is volume 51 in the *Methods in Enzymology* series.

Jones was elected to the Institute of Medicine in 1981 and the National Academy of Sciences in 1984, and held several distinguished appointments, such as member of the grants committee of the American Cancer Society (1971–1973), member of the metabolic biology study section of the National Science Foundation (1978–1981), and member of the science advisory board for the National Heart, Lung, and Blood Institute, National Institutes of Health (1980–1984). Her extensive professional service included terms as president of the Association of Medical School Departments of Biochemistry (1985), American Society for Biochemistry and Molecular Biology (1986), American Society of Biological Chemists (1986), and American Association of University Professors (1988).

Among her numerous awards were the Wilbur L. Cross Medal from Yale University (1982), a Distinguished Chemist award of the North Carolina American Chemical Society (1986), the Thomas Jefferson Award from the University of North Carolina (1990), and an Award in Science from the state of North Carolina (1991). A major research building is named after her at the University of North Carolina, Chapel Hill medical school. She was elected a fellow of the American Association for the Advancement of Science, and was also a member of the American Chemical Society and the American Philosophical Society.

Further Resources

Traut, Thomas W. "Mary Ellen Jones, December 25, 1922 August 23, 1996." <http://www.nap.edu/html/biomems/mjones.html>.

K

Kalnay, Eugenia

b. 1942

Meteorologist

Education: license, meteorology, University of Buenos Aires, Argentina, 1965; Ph.D., meteorology, Massachusetts Institute of Technology, 1971

Professional Experience: assistant professor, University of Montevideo, Uruguay, 1971–1973; assistant to associate professor, Massachusetts Institute of Technology (MIT), 1973–1979; senior research meteorologist, Global Modeling and Simulation, National Aeronautics and Space Administration (NASA)/Goddard Space Flight Center, 1979–1984, director, 1984–1986; director, Environmental Modeling Center (EMC), National Centers for Environmental Prediction (NCEP), Maryland, 1987–1997, senior scientist, 1998–2000; Robert E. Lowry Chair in Meteorology, University of Oklahoma, 1997–1999; professor, meteorology, University of Maryland, 1999–2001, Distinguished University Professor, 2001–, Eugenia Brin Professor in Data Assimilation, 2008–

Eugenia Kalnay is a meteorologist who studies global weather forecasting and atmospheric weather dynamics. She uses computer modeling for numerical weather predictions. She was the first woman to get a Ph.D. in meteorology from MIT. She has been an outspoken critic of those, including other scientists, who deny humankind's role in global climate change. She is the author of a popular textbook, *Atmospheric Modeling, Data Assimilation and Predictability* (2002).

Kalnay was born in Argentina, the seventh of eight children, to Hungarian and Swiss parents. Her father died when she was a teenager, but her mother encouraged and supported her education. Kalnay enrolled at the University of Buenos Aires intending to study physics, but her mother chose meteorology as her major due to the availability of scholarships and job opportunities. She received her degree in 1965 and relocated to Massachusetts to study at MIT. She married and had a child while in graduate school, and was the only female student in the meteorology program at MIT. She received her doctorate in 1971 and then returned to South America to teach in Uruguay for two years. She returned to MIT in 1973 as a research associate and then faculty member. She was then offered a position with NASA in the Global Modeling and Simulation laboratory. The NASA job required



Meteorologist, Eugenia Kalnay. (Courtesy of University Publications, University of Maryland)

that she finally secure U.S. citizenship, which she did in 1978. She then joined the EMC/NCEP, where she oversaw the work of a team of scientists compiling computer modeling information on atmospheric and ocean climates for the National Weather Service. After 10 years, however, she stepped down as director of the EMC and returned to academic research as professor of meteorology at the University of Oklahoma and then the University of Maryland.

Kalnay was elected to the National Academy of Engineering in 1996 and has been named a foreign member of the Academia Europaea (2000) and a corresponding member of the Argentine National Academy of Physical Sciences (2003). She is also a fellow of American Geophysical Union, American Meteorological Society, and the American Academy of Arts and

Sciences. She has received Gold and Silver Medals from the U.S. Department of Commerce, a NASA Medal for Exceptional Scientific Achievement (1981), the Jule G. Charney Award of AMS (1995), the Presidential Rank Award for Meritorious Achievement (1997), the Kirwan Award of the University of Maryland (2006), and the IMO Prize of the World Meteorological Organization (2009). In 2008, she received an honorary doctorate from the University of Buenos Aires.

Further Resources

University of Maryland. Faculty website. <http://www.atmos.umd.edu/~ekalnay/>.

Kanter, Rosabeth (Moss)

b. 1943

Sociologist, Management Consultant

Education: student, University of Chicago, 1962–1963; B.A., Bryn Mawr College, 1964; M.A., University of Michigan, 1965, Ph.D., sociology, 1967

Professional Experience: instructor, sociology, University of Michigan, 1967; assistant professor, sociology, Brandeis University, 1967–1973; associate professor, administration, Harvard University, 1973–1974; associate professor, sociology, Brandeis, 1974–1977; associate professor, sociology, Yale University, 1977–1978, professor, 1978–1986; professor, Harvard University Business School, 1986–2000, Ernest L. Arbuckle professor of business administration, 2000–

Concurrent Positions: visiting scholar, Newberry Library, 1973; visiting scholar, Harvard University, 1975; faculty member, Young President’s Organization of International University, Hong Kong, 1976; founding partner, Goodmeasure, Inc., 1977– ; scholar-in-residence, Miami University, Ohio, 1978; visiting professor, Organizational Psychology and Management, Sloan School of Management, Massachusetts Institute of Technology, 1979–1980; director, American Center for Quality of Work Life, 1978–1982; director, Educational Fund for Individual Rights, 1979–1984; director, Legal Defense and Education Fund, National Organization for Women, 1979–1986 and 1993–1995; visiting scholar, Norwegian Research Council on Science and Humanities, 1980; editor, *Harvard Business Review*, 1989–1992

Rosabeth Moss Kanter brought a multidisciplinary perspective to the study of organizations and revolutionized management by introducing humanism into the workplace. In her landmark book, *Men and Women of the Corporation* (1977), she debunked the notion that the right personality is the key ingredient for success. Her research indicated that the structure of a company and a person’s position within it determines her or his behavior and chances of promotion. Her statements that people can be products of their jobs, not the reverse, was particularly important for women, who usually are told they do not have the personality to be managers, when they have never been able to develop leadership skills in low-level, powerless jobs.

Kanter’s earlier research was on the sociology of communal living. She moved from the study of communes to corporations and, in 1977, she and her husband, Barry Stein, established their own management consulting firm, Goodmeasure, Inc. They co-authored *A Tale of “O”* (1980), which described in a whimsical manner how “x’s” and “o’s” are treated differently and revealed the insidious effect of discrimination in organizations. In *The Change Masters: Innovation for Productivity in the American Corporation* (1983), she advised companies on the idea of “intrapreneurship,” or how to stimulate entrepreneurial efforts from employees within an organization. Kanter has kept up with changes affecting American corporations, and in *World Class: Thriving Locally in the Global Economy* (1995), she emphasized the alternatives to job insecurity and economic chaos that have been brought on by the increasing globalization of industry. Many of her published

articles on topics of strategy, innovation, and leadership were collected in the book *Rosabeth Moss Kanter on the Frontiers of Management* (1997; 2nd ed., 2003). Her other books include *Innovation: Breakthrough Thinking at Du Pont, GE, Pfizer, and Rubbermaid* (1997), *Evolve!: Succeeding in the Digital Culture of Tomorrow* (2001), and *Confidence: How Winning Streaks and Losing Streaks Begin and End* (2004).

Kanter has been a board member, trustee, or consultant to numerous businesses, organizations, and government entities. She has also been an advisor to political campaigns, working closely with Governor Michael Dukakis of Massachusetts in his campaign for the presidency in 1988. She and Dukakis wrote *Creating the Future: The Massachusetts Comeback and Its Promise for America* (1988). In 1994, Massachusetts governor William Weld appointed her to his Council on Economic Growth and Technology and named her co-chair of his International Trade Task Force. She is also a member of the American Sociological Association, American Association for Higher Education, and Society for the Study of Social Problems.

Further Resources

Harvard Business School. Faculty website. <http://drfd.hbs.edu/fit/public/facultyInfo.do?facInfo=ovr&facId=6486>.

Kanwisher, Nancy

Psychologist

Education: B.S., biology, Massachusetts Institute of Technology, 1980, Ph.D., cognitive psychology, 1986

Professional Experience: visiting scholar, Institute for War and Peace Studies, Columbia University, 1986–1987; postdoctoral fellow, psychology, Harvard University, 1987–1988; assistant research psychologist, psychology, University of California, Berkeley, 1988–1990; assistant and associate professor, psychology, University of California, Los Angeles, 1990–1994; assistant professor and John L. Loeb Associate Professor of the Social Sciences, psychology, Harvard University, 1994–1997; associate professor, Brain and Cognitive Sciences, Massachusetts Institute of Technology (MIT), 1997–2001, professor, 2001–, Ellen Swallow Richards Professor, 2004–2009, Walter A. Rosenblith Professor, 2009–

Concurrent Positions: assistant in neuroscience, Department of Radiology, Massachusetts General Hospital, 2000–; investigator, McGovern Institute for Brain Research, MIT, 2000–

Nancy Kanwisher is a psychologist who studies visual perception, including object recognition, attention, number recognition, and social cognition. Her work combines cognitive and neurological research methods and tools. One of her main contributions to the field of cognitive neuroscience has been the identification of an area of the brain she terms FFA (Fusiform Face Area), which is dedicated to processing facial recognition. Using magnetic resonance imaging, or an MRI, to track brain activity, Kanwisher has found that, even when vision is not impaired, neurological injury or problems with this specific area can impact a patient's ability to recognize faces. Her research has also revealed other dedicated areas of the brain that process specific imagery related to other body parts, such as feet or elbows. These findings have unlimited implications for uncovering the previously unknown function of other brain regions, and for further research into the role of genetics, evolutionary biology, and environmental or social conditioning on the development of specific areas of the brain.

Kanwisher received her doctorate in cognitive psychology from MIT in 1986 and taught at several universities on the East Coast and California before returning to MIT as a faculty member in the Department of Brain and Cognitive Sciences in 1997. Since 2000, she has also been an Investigator at MIT's McGovern Institute for Brain Research. The McGovern Institute brings together researchers on brain function specifically for the purpose of understanding physical and cognitive brain disorders, diseases, and injuries. She has been an invited lecturer, committee member, and advisor for numerous schools and institutions throughout the United States and abroad. She has published widely, including collaborations with Harvard psychologist **Elizabeth Spelke**, and served on the editorial boards of professional journals such as *Current Opinion in Neurobiology*, *Cognition*, *Journal of Neuroscience*, *Journal of Experimental Psychology*, and several others.

Kanwisher was elected to the National Academy of Sciences in 2005. She is a fellow of the American Academy of Arts and Sciences and the Society of Experimental Psychologists, and was named a MacVicar Faculty Fellow at MIT (2002). She is also the recipient of a MacArthur Foundation Fellowship in Peace and International Security (1986–1988), a National Institute of Mental Health FIRST Award (1988–1992), a National Academy of Sciences Troland Research Award (1999), and a Golden Brain Award of the Minerva Foundation (2007).

Further Resources

McGovern Institute. "Nancy Kanwisher." <http://web.mit.edu/mcgovern/html/PrincipalInvestigators/kanwisher.shtml>.

Massachusetts Institute of Technology. "Kanwisher Lab." <http://web.mit.edu/bcs/nklab/>.

Karle, Isabella Helen Lugoski

b. 1921

Crystallographer

Education: B.S., University of Michigan, M.S., physical chemistry, 1942, Ph.D., physical chemistry, 1944

Professional Experience: associate chemist, University of Chicago, 1944; instructor, chemistry, University of Michigan, Ann Arbor, 1944–1946; physicist, Naval Research Laboratory (NRL), 1946–1959, scientist, x-ray defraction and structural chemistry, 1959–2009

Isabella Karle is a chemist and physicist who, along with her husband Jerome Karle and others, developed a new mathematical technique called “direct methods” in crystallography, or the study of the atomic structure and composition of crystals. Her research interests have included application of electron and x-ray diffraction to structure problems, phase determination in crystallography, elucidation of molecular formulae, peptides, and configurations and conformations of natural products and biologically active materials. Jerome (who was a co-recipient of the Nobel Prize in Chemistry in 1985) was the theorist and Isabella the experimentalist. He and others developed the theory of direct method, but she applied their theories by designing a machine that could diffract and photograph images of crystals to determine their atomic structures, speeding up the process and thus revolutionizing the field. Karle’s study of frog venom and other biological materials allowed advances in creating synthetic chemicals for everything from insect repellents to medicines. She published more than 200 scientific papers and has received several honorary degrees. She has been a consultant or advisor to government agencies, including the National Committee on Crystallography, the National Research Council, and the Atomic Energy Commission.

Isabella Karle completed her undergraduate degree on a four-year fellowship and received her doctorate at the age of 22, but she was unable to secure a graduate teaching assistantship in chemistry at Michigan because women had never held such a position. She was granted a fellowship by the American Association of University Women to start her graduate studies. After she received her doctorate, she and Jerome worked at the University of Chicago on the Manhattan Project for six months, and then Isabella returned to the University of Michigan for a short time. The couple was unable to obtain suitable employment together in a university due to anti-nepotism rules, but the U.S. Naval Research Laboratory (NRL) offered them an opportunity to work together beginning in 1946, and they were affiliated with the NRL until their joint retirement in July 2009.

Isabella Karle was elected to membership in the National Academy of Sciences in 1978 and received a National Medal of Science from President Clinton in 1995. Her awards and honors over the course of a long career are numerous, but they include eight honorary doctorates as well as a Superior Civilian Service Award of the Navy Department (1965), Annual Achievement Award of the Society of Women Engineers (1968), Hildebrand Award from the American Chemical Society (1969), Federal Woman's Award (1973), Garvan Medal of the American Chemical Society (1976), Pioneer Award from the American Institute of Chemists (1984), Women in Science and Engineering Lifetime Achievement Award (1986), Gregori Aminoff Prize of the Swedish Academy of Sciences (1988), Bijvoet Medal from the University of Utrecht, Netherlands (1990), Bower Award and Prize for Achievement in Science from the Franklin Institute (1993), U.S. Department of Defense Distinguished Civilian Service Award (1995), and Merrifield Award of the American Peptide Society (2007). She is a member of the American Crystallographic Association (president, 1976), the American Physical Society, and the American Chemical Society. Jerome and Isabella Karle had three daughters, all of whom pursued degrees in the sciences.

Further Resources

Naval Research Laboratory. "Jerome and Isabella Karle Retire from NRL Following Six Decades of Scientific Exploration." Press release. (21 July 2009). <http://www.nrl.navy.mil/pao/pressRelease.php?Y=2009&R=58-09r>.

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

Karp, Carol Ruth (Vander Velde)

1926–1972

Mathematician

Education: B.A., Manchester College, 1948; M.A., Michigan State University, 1950; Ph.D., mathematics, University of Southern California, 1959

Professional Experience: instructor, mathematics, New Mexico Agricultural and Mechanical College (now New Mexico State University), 1953–1954; instructor, mathematics, University of Maryland, 1958–1960, assistant to associate professor, 1960–1966, professor, 1966–1972

Carol Karp was renowned for her research on logic, particularly infinitary logic in mathematics. Logic is the science that investigates the principles governing correct or reliable inference, and her book *Languages with Expressions of Infinite Length*

(1964), based on her doctoral thesis, was the first systematic explanation of the theory of infinitary logic. In infinitary logic, a modification of calculus, the formulas are formed from symbols representing variables, constants, functions, and relations. Karp introduced four new symbols representing conjunction of infinite sets. Her work was internationally recognized, and she was able to recruit other faculty and a steady stream of graduate students to the University of Maryland. She was instrumental in bringing several important participants to the colloquia that she sponsored, and she and her husband even had a home with an extra apartment in which visiting logicians were frequently housed. Karp's intellectual standards were extremely high, and she was unfailingly honest in appraising the mathematical contributions and research promise of her students, refusing to let anyone graduate until their results met her own high standards for publishability.

Karp developed breast cancer in 1969, but she continued her schedule of teaching and research until 1971, when she was too ill to work. At the time of her death in 1972, she was working on a second book, but it was still too incomplete to publish. Colleagues and friends prepared a memorial volume, *Infinitary Logic: In Memoriam Carol Karp* (1975), which incorporates many of her ideas and notes. She was a member of the American Mathematical Society, Mathematical Association of America, and Association for Symbolic Logic.

Further Resources

Agnes Scott College. "Carol Karp." Biographies of Women Mathematicians. <http://www.agnesscott.edu/lriddle/women/karp.htm>.

Kaufman, Joyce (Jacobson)

b. 1929

Chemist, Pharmacologist

Education: B.S., Johns Hopkins University, 1949, M.A., 1959, Ph.D., chemistry and chemical physics, 1960; DES, theoretical physics, Sorbonne, 1963

Professional Experience: research chemist, U.S. Army Chemical Center, Maryland, 1949–1952; research assistant, Johns Hopkins University, 1952–1960; staff scientist, Martin Company Research Institute for Advanced Studies, 1960–1962, head, quantum, chemistry group, 1962–1969; associate professor of anesthesiology, School of Medicine, and principal research scientist in chemistry, Johns Hopkins University, 1969–1977, associate professor, Department of Surgery, 1977–

Joyce Kaufman has gained a distinguished national and international reputation in a wide variety of fields—chemistry, physics, biomedicine, and supercomputers—on

both the experimental and the theoretical levels. Her specialties include theoretical quantum chemistry, experimental physical chemistry, and chemical physics of energetic compounds; the last includes explosives, rocket fuels, oxidizers, and energetic polymers. She has examined the application of those techniques and experimental animal studies to biomedical research, including pharmacology, drug design, and toxicology. She is also knowledgeable in nuclear chemistry and radiochemistry, and has been successful in using experimental chemical techniques in determining the guidelines for effective drug action in a number of different areas. She published a landmark paper in 1980 in which she introduced a new theoretical method for coding and retrieving certain carcinogenic polycyclic aromatic hydrocarbons. Since that time, at least 30 papers have been written by other researchers using and expanding upon her concept. At Johns Hopkins School of Medicine, she works with interns and residents studying the effect of drugs, such as narcotics, tranquilizers, psychotropic drugs, general anesthetics, and spinal anesthetics, on the central nervous system.

Kaufman completed high school in two years and, after receiving her undergraduate degree, worked as a librarian at the Army Chemical Center, where she set up a scientific indexing system for their technical reports. During the 1950s, it was common practice for companies and agencies to hire women scientists as librarians specializing in scientific literature rather than to employ them in the laboratories. However, Kaufman was able to transfer to a position as a research chemist after one year. A chemistry professor at Johns Hopkins invited her to work with him on a research contract, and he later convinced her to obtain a doctorate. She later joined Martin Company's Research Institute for Advanced Studies to do theoretical research on the application of quantum mechanics to problems in chemistry, but returned to Johns Hopkins in 1969 as a professor and research scientist.

Kaufman has received numerous awards, including the Gold Medal of the Martin Company each year for three years (1964–1966), the Dame Chevalier of the Centre National de la Recherche Scientifique, France (1969), the Garvan Medal of the American Chemical Society (1974), and a Woman of Achievement Award from the Jewish National Fund (1974). She is a fellow of the American Physical Society, American Institute of Chemists, and the European Academy of Science, Arts, and Letters.

Keller, Evelyn Fox

b. 1936

Physicist, Mathematical Biologist, Molecular Biologist

Education: student, Queens College, 1953; B.A., Brandeis University, 1957; M.A., Radcliffe College, 1959; Ph.D., physics, Harvard University, 1963



Physicist, biologist, and feminist scholar, Evelyn Fox Keller. (Photograph by Marleen Wynants)

Massachusetts Institute of Technology, 1979–1980, visiting scholar, 1980–1984, visiting professor, 1985–1986

Professional Experience: instructor, New York University, 1962–1963, assistant research scientist, 1963–1966; assistant professor, Graduate School of Medical Science, Cornell University, 1966–1969; associate professor of molecular biology, New York University, 1970–1972; associate professor, Division of Natural Science, State University of New York (SUNY) at Purchase, 1972–1982; professor of humanities and mathematics, Northeastern University, 1982; senior fellow, Cornell University, 1986–1987; professor of rhetoric, Women's Studies and History of Science, University of California, Berkeley, 1989–1992; professor, history and philosophy of science, Massachusetts Institute of Technology, 1992–

Concurrent Positions: visiting fellow,

Evelyn Fox Keller is known for her work in the fields of theoretical physics, molecular biology, and mathematical biology, as well as her feminist critique of scientific methods and beliefs. She was drawn to physics as a means for deep inquiry into nature, and received a National Science Foundation fellowship to attend Harvard. She did not enjoy the competitive and discriminatory atmosphere at Harvard and was ready to quit school after two years. A summer at the Cold Spring Harbor Laboratory, however, inspired her finish her thesis on molecular biology, and she received her doctorate in physics in 1963.

While teaching a women's studies course in New York in 1974, she began to question the treatment of women in the sciences. An article on geneticist **Barbara McClintock** turned into a full biography, *A Feeling for the Organism: The Life of Barbara McClintock*, which Keller published in 1983. McClintock had worked for years in relative obscurity at Cold Spring Harbor on the genetics of maize. She had discovered that some genes move from one area on the chromosome to another, but her work was ignored for many years. McClintock received the Nobel Prize for this discovery more than 30 years after publishing her first findings. Keller generated

controversy with her next book, *Reflections on Gender and Science* (1985), in which she emphasized the importance of intuition in science and speculated on what a truly gender-free science might look like. Her recent works include *The Century of the Gene* (2000), and *Making Sense of Life: Explaining Biological Development with Models, Metaphors and Machines* (2002).

Fox Keller has received numerous awards and recognitions, including the Blaise Pascal Research Chair by the Préfecture de la Région D'Ile-de-France (2005–2007). She is a member of the American Philosophical Society and the American Academy of Arts and Science.

Further Resources

Massachusetts Institute of Technology. Faculty website. <http://web.mit.edu/sts/people/keller.html>.

Kempf, Martine

b. 1958

Computer Scientist

Education: student, astronomy, Friedrich Wilhelm University, Bonn, 1981–1983

Professional Experience: founder and CEO, Kempf USA, 1985–, CEO, Kempf SAS, 2002–

Martine Kempf is known for her research on voice commands for computer programs. In 1985, she invented a breakthrough voice recognition microcomputer dubbed Katalavox, a name derived from the Greek word *katal*, “to understand,” and *vox*, which is Latin for “voice.” While she was a student in Bonn, she saw many German teenagers who had been born without arms because their mothers had taken thalidomide during pregnancy, and reasoned that a voice recognition system would enable them to drive cars. Learning to program on an Apple computer, she succeeded in directly transforming the human voice’s analog signals into the computer’s digital signals. Further refinements enable Katalavox to respond to a spoken command in a fraction of a second, compared with one or two seconds for competing systems. She was unable to secure financing to start a company in France, so she moved to Sunnyvale, California, to create and market the voice-recognition device not only for drivers, but also for people confined to wheelchairs or who suffer from cerebral palsy or strokes, and for doctors to use surgical tools and microscopes hands-free.

Kempf was an astronomy student who does not hold a higher degree, but taught herself electronics and computers. She not only designed the software for her

device but designed and built the hardware, designing the board and soldering the circuits herself. She also invented the Comeldir Multiplex Handicapped Driving Systems for people who must operate cars with their feet rather than their hands. Kempf's own father was a polio survivor who designed a car he could drive with his hands and created a business customizing more than 1,000 cars per year for others with disabilities. Martine's company, Kempf USA, is still headquartered in California, and she became CEO of Kempf SAS in Europe (her father's business) after his death in 2002.

Further Resources

Kempf USA. "Who is Martine KEMPF?" <http://www.kempf-usa.com/KempfMartine.html>.

Kenyon, Cynthia J.

b. 1955

Molecular Biologist

Education: B.S., chemistry and biochemistry, University of Georgia, 1976; Ph.D., biology, Massachusetts Institute of Technology, 1981

Professional Experience: postdoctoral fellow, Medical Research Council Laboratory of Molecular Biology, Cambridge, England, 1982–1986; assistant professor, biochemistry and biophysics, University of California, San Francisco (UCSF), 1986–1992, associate professor, 1992–1994, professor, 1994–

Concurrent Positions: director, UCSF Hillblom Center for the Biology of Aging, 2002–

Cynthia Kenyon is a molecular biologist known for her studies of the genes of a microscopic roundworm or nematode called *Caenorhabditis elegans*, or *C. elegans*. Her findings that gene mutations were responsible for determining the life span of *C. elegans* led to further research on the genetic role in aging and age-related diseases (such as heart disease, cancer, diabetes, or Huntington's disease) in other organisms, such as mice or humans. By altering the genes of the *C. elegans* hormonally and environmentally, Kenyon found that she could increase the worm's life span by as much as 50% compared to normal, from 21 days to 45 days in some cases. While the implications for the human aging process are still being researched, she has reported that her findings have at least prompted her to think about her own aging; for example, finding that too much sugar shortened the worm's life span, she made dietary changes to limit the amount of high-glycemic

index carbohydrates she eats, avoiding white flour and sugar. These dietary changes also promote weight loss and regulate insulin production, which can also ward off disease. In 1999, she co-founded a company, Elixir Pharmaceuticals, to research the development of medications that could slow down the aging process and treat metabolic disorders.

Kenyon earned her undergraduate degree in chemistry from the University of Georgia in 1976 and went on to receive a doctorate from the Massachusetts Institute of Technology in 1981. Her thesis was on DNA damage in *E. coli*. She then went to Cambridge, England as a postdoctoral molecular biology researcher in the laboratory of Nobel Laureate Sydney Brenner, where she began studying *C. elegans*. She joined the faculty at UCSF in 1986, where she was Herbert Boyer Distinguished Professor of Biochemistry and Biophysics (1997–2004), and in 2005 was named an American Cancer Research Society Professor. She is also the founding director of the Hillblom Center for the Biology of Aging at UCSF, established in 2002.

Kenyon was elected to both the National Academy of Sciences and the Institute of Medicine in 2003. She is a fellow of the American Academy of Arts and Sciences and the Genetics Society of America (president, 2003). Her most recent awards and honors include the King Faisal International Prize for Medicine (2000), Life Extension Prize (2002), Discover Prize for Basic Research (2004), American Association of Medical Colleges Award for Distinguished Research in Biomedical Sciences (2004), Ilse & Helmut Wachter Award for Exceptional Scientific Achievement in the Field of Medicine (2005), and La Fondation IPSSEN Prize (2006).

Further Resources

University of California, San Francisco. “Kenyon Lab.” <http://kenyonlab.ucsf.edu/>.



Molecular biologist Cynthia Kenyon researches the genetic role in aging and age-related diseases. (AP/Wide World Photos)

Kidwell, Margaret Gale

b. 1933

Geneticist, Evolutionary Biologist

Education: B.Sc., Nottingham University, 1953; M.S., animal breeding, Iowa State University, 1962; Ph.D., genetics, Brown University, 1973

Professional Experience: officer, Ministry of Agriculture, London, 1955–1960; research fellow, Brown University, 1973–1974, research associate, 1974–1975, investigator, 1975–1977, assistant to associate professor, 1977–1984, professor, 1984–1985; professor, ecology and evolutionary biology, University of Arizona, Tucson, 1985–

Margaret Kidwell is renowned for her research on *Drosophila*, the common fruit fly. Her research interests include *Drosophila* genetics and evolution, recombination transposable elements, and speciation. In the 1990s, her team discovered that sometime around 1950, genes of one fruit fly jumped to another species. Since that time, “the jumping genes” have spread like wildfire, so that today, essentially all fruit fly populations, except those maintained in isolation in laboratories, carry the same elements. The theory is that a tiny parasitic mite lives in association with both species. Although there have been reports of other possible gene transfers between species, principally by viruses, this discovery was the first indication that a mite or anything like it can transfer genetic material. The transfer of genetic material between species has a major impact on our understanding of evolution, as the “transposons” cause mutations if they happen to land in a gene. However, if lateral transfers of genetic material between species occur frequently, that could complicate the work of researchers who are attempting to study the evolutionary relationships among species. Kidwell, a pioneer in this research, was the one who zeroed in on the mite. Since the two species of fruit flies cannot breed, the team recognized that the material had to have been transferred by some agent.

Born in England, Kidwell came to the United States in 1960 with a fellowship to pursue graduate study, receiving a master’s degree from Iowa State and her doctorate from Brown University in 1973 at the age of 40. She had originally planned to return to England, but discovered she wanted to pursue a research career in the United States, and had married an American and started a family as well. While still in graduate school, she accepted a position at Brown as a research scientist, then moved into the academic ranks as an assistant professor in 1977. She became a full professor at Brown in 1985 but was recruited to the University of Arizona as professor of ecology and evolutionary biology and in affiliation with the Interdisciplinary Program in Genetics.

Kidwell was elected to membership in the National Academy of Sciences in 1996. She is a fellow of the American Association for the Advancement of Science and of the American Academy of Arts and Letters, and a member of the American Genetics Association (president, 1992), Society for Molecular Biology and Evolution (1996), American Society of Naturalists (vice president, 1984), Genetics Society of America, and Society for the Study of Evolution. Kidwell had two daughters, both of whom pursued advanced degrees in the biological sciences.

Further Resources

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

University of Arizona. Faculty website. <http://www.eebweb.arizona.edu/Faculty/Bios/kidwell.html>.

Kieffer, Susan Werner

b. 1942

Geologist, Volcanologist, Mineral Physicist

Education: B.S., physics and mathematics, Allegheny College, 1964; student, astrophysics (solar physics), University of Colorado, Boulder, 1964–1965; M.Sc., geological sciences, California Institute of Technology, 1967, Ph.D., planetary science, 1971

Professional Experience: postdoctoral research fellow, University of California, Los Angeles, 1971–1973, assistant to associate professor, geology, 1973–1979; geologist, U.S. Geological Survey (USGS), Flagstaff, Arizona, 1979–1990, scientist emeritus; professor, geology, Arizona State University, 1990–1993; professor and department head, geological science, University of British Columbia, 1993–1995; co-founder and head, Kieffer & Woo, Inc., Ontario, 1996–2000; professor, geology and physics, Center for Advanced Study, and affiliated faculty member, civil and environmental engineering, University of Illinois, Urbana-Champaign, 2000–

Concurrent Positions: visiting professor, geology, California Institute of Technology, 1982; research professor, geology, Arizona State University, 1989; co-founder and president, Kieffer Institute for Development of Science-Based Education, Arizona, 1999; founder, S. W. Kieffer Science Consulting Inc., 2000–

Susan Kieffer is renowned as an expert on volcanoes both on Earth and on Io, Venus, Mars, and other planets. Her research includes geological physics, high-pressure

geophysics and impact processes, shock metamorphism of natural materials, thermodynamic properties of minerals, mechanisms of geyser and volcano eruptions, and river hydraulics. Her expertise on the hydraulics of lava flow also transfers to her studies of the hydraulics, sediment transfer, rapids, and waves in rivers. She also participated in the studies of asteroid impact on Earth at the Chicxulub crater in Mexico. She has studied geysers, volcanoes, and the volcanic environment on Earth as well as on other planets and has found that simulated volcanic eruptions on Earth, Venus, and Mars produce plumes with different fluid dynamic regimes. A major portion of the differences are caused by differing atmospheric pressures and ratios of volcanic vent pressure to atmospheric pressure. She did extensive studies of the hydraulics of lava flow and erosion furrows after the eruption of Mount St. Helens in Washington State in 1980, research which earned her team a USGS Group Achievement Award. She has also studied the hydraulics of river flow in areas such as the Colorado River, and explored Old Faithful in Yellowstone National Park by lowering a robot down its vent.

Although it is commonplace for asteroids to strike other planets, it is a comparatively rare occurrence when they strike Earth. Kieffer collaborated with Walter Alvarez in his study of the crater left by an asteroid striking the Earth at Chicxulub in Mexico, a study that supported Alvarez's theory that the dust cloud from this impact blotted out the sun while circling the Earth, thus killing the vegetation that was the food supply for the dinosaurs. Kieffer and Alvarez co-authored a paper about the study, and the research is also discussed in Alvarez's book *T-Rex and the Crater of Doom* (1997).

She has worked for government agencies as well as for several universities. After receiving her doctorate, she secured a position as a research geophysicist at the University of California, Los Angeles, and then transferred to a tenure-track academic position. She worked for the USGS for more than a decade, then returned to academia as a professor at Arizona State University before moving to the University of British Columbia in 1993. In 1996, she co-founded Kieffer & Woo, a consulting firm in Canada, and was chair of the Canadian Geoscience Council (CGC) committee on Geologic Disposal of High-Level Nuclear Fuel Waste. Most recently, she has consulted on volcanic intrusions into waste repositories for the Nuclear Waste Technical Review Board. In 2000 she became a professor of geology and physics at the University of Illinois, Urbana-Champaign.

Kieffer was elected to membership in the National Academy of Sciences in 1986. She received a prestigious five-year MacArthur fellowship (1995–2000), and has also received the Mineralogical Society of America Award (1980), Distinguished Alumnus Award of California Institute of Technology (1982), Meritorious Service Award of the Department of Interior (1987), Spendiarov Prize of the Soviet Academy of Sciences (1989), and Day Medal of the Geological Society

of America (1992). She is the co-editor of *Microscopic to Macroscopic Atomic Environments to Mineral Thermodynamics* (1985). She is a fellow of the American Geophysical Union and the American Association for the Advancement of Science (chair of Geology/Geography Section, 2002–2005), and a member of the Meteoritical Society, Geological Society of America, Geological Association of Canada, Society of Canadian Women in Science and Technology, and American Academy of Arts and Sciences.

Further Resources

University of Illinois. “The Geological Fluid Dynamics Group.” <http://www.geology.uiuc.edu/~skieffer/>.

Kimble, Judith

b. 1949

Geneticist

Education: B.A., University of California, Berkeley, 1971; Ph.D., biology, University of Colorado, Boulder, 1978

Professional Experience: postdoctoral fellow, Laboratory of Molecular Biology, Cambridge, England, 1978–1982; assistant to associate professor, molecular biology and biochemistry, University of Wisconsin, Madison, 1983–1992, professor, 1992–

Concurrent Positions: investigator, Howard Hughes Medical Institute, 1994–

Judith Kimble is renowned for her research on *elegans*, a type of nematode—unsegmented worms of the phylum Nematoda that have elongated, cylindrical bodies. Her research concerns understanding animal development at the molecular and cellular levels. She became interested in this field after studying human embryology as an undergraduate and realized that understanding stem cells and organ development of the simplest animals would have implications for understanding all animals, including humans. After completing her undergraduate degree at Berkeley, Kimble spent two years at the University of Copenhagen Medical School as an assistant before she received a National Science Foundation predoctoral fellowship at the University of Colorado, Boulder. After receiving her doctorate, she was a postdoctoral fellow at the Laboratory of Molecular Biology in Cambridge, England, and went on to receive prestigious postdoctoral fellowships, including one from the National Institutes of Health (1980–1982). Kimble joined the faculty in molecular biology, biochemistry, and medical genetics at the

University of Wisconsin, Madison. She has published widely in scientific journals such as *Developmental Biology*; *Genetics*; *Cell*; *Developmental Genetics*; and *Proceedings of the National Academy of Sciences*.

Kimble was elected to membership in the National Academy of Sciences (NAS) in 1995 and was recently elected to a term on the Council of the NAS (2008–). She received a National Institutes of Health Research Career Development Award (1984–1989), and has served on several prestigious committees, such as the Damon Runyon–Walter Winchell Cancer Research Fund Scientific Advisory Board (1992–1996) and the Searle Scientific Advisory Board (1997–). She has been active in professional organizations, such as the Society of Developmental Biology (secretary, 1987–1990; president, 2004–2005), Genetics Society of America (president, 2000), and American Society for Cell Biology (council member, 1994–). She is also a member of the American Academy of Arts and Sciences and the American Philosophical Society.

Further Resources

University of Wisconsin. Faculty website. <http://www.biochem.wisc.edu/faculty/kimble/>.

King, Helen Dean

1869–1955

Geneticist

Education: B.A., Vassar College, 1892; Ph.D., morphology, Bryn Mawr College, 1899

Professional Experience: fellow, biology, Bryn Mawr College, 1896–1897, assistant, 1899–1904; instructor, science, Baldwin School, Pennsylvania, 1899–1907; fellow, biology, University of Pennsylvania, 1906–1908; assistant, anatomy, Wistar Institute of Anatomy and Biology, 1909–1912, assistant professor, anatomy, 1912–1927, professor, embryology, 1927–1949

Helen King's outstanding contribution to science was her success in breeding pure strains of laboratory animals, including 150 generations of rats and the “Wistar” rat (named after the Institute where she worked for 40 years) that became widely used as a lab animal. In addition to discovering new types of rats, her research shed light on inquiries into heredity, sex determination, fertility, and longevity. Through careful inbreeding experiments with brother and sister rats, a practice unpopular at the time, she demonstrated the capacity to improve the strain, knowledge that has been applied to other animals, such as racehorses. Her research was reported in the

newspapers in the 1910s and 1920s at a time when there was great interest in eugenics. Her work on rats sparked controversy and outrage over whether she was advocating “human inbreeding” or incest. Her other research interests included sex determination in amphibians and mammals, germ cells in amphibians and mammals, parthenogenesis, growth and reproduction of the white rat, and modification of the sex ratio.

After she received her doctorate from Bryn Mawr, she remained at the school as an assistant in biology and also taught science at the Baldwin School before accepting a research fellow position at the University of Pennsylvania. She moved to the Wistar Institute of Anatomy and Biology in Philadelphia in 1909, where she spent the remainder of her career. She served on the institute’s advisory board for 24 years, was editor of its bibliographic service for 13 years, and was editor of the *Journal of Morphology and Physiology* for 3 years.

King received many honors and awards for her work, including the Ellen Richards Prize of the Association to Aid Scientific Research for Women in 1932. She was elected a fellow of the New York Academy of Sciences. Her other memberships included the American Association for the Advancement of Science, the American Society of Naturalists, the American Society of Zoologists, and the American Association of Anatomists.

King, Mary-Claire

b. 1946

Geneticist, Epidemiologist

Education: B.A., mathematics, Carleton College, 1966; Ph.D., genetics, University of California, Berkeley, 1973

Professional Experience: visiting professor, University of Chile, Santiago, 1973; assistant professor, epidemiology, School of Public Health, University of California, Berkeley, 1974–1980, associate professor, epidemiology, 1980–1984, professor, epidemiology, 1984–1996, professor, genetics and molecular biology, 1989–1996, American Cancer Society Professor, genetics and epidemiology, 1994–1996; professor, Genome Sciences and Medicine, University of Washington, 1996–

Mary-Claire King is renowned for her research on breast cancer. In 1990, she predicted the existence of the gene BRCA1 that, if damaged, can predispose women to breast and ovarian cancer. The next year, she and other researchers discovered the chromosomal location of a gene that causes a form of inherited deafness, and



Geneticist Mary-Claire King. (Courtesy of University of Washington/UnivPhoto)

another of her discoveries consists of the genetic clues to the reason some men infected with HIV-1 develop AIDS more rapidly than others. She began her research on breast cancer in the 1970s, but made very little headway until the early 1980s, when breakthroughs in molecular biology led to the mapping of more genetic markers. Her team was very close to finding the gene BRCA1 when it was located by a team at the University of Utah in 1994. Although disappointed, she continued her work on the location of other genes and on gene mutations. As a scientist, but also as a person with a family history of breast and ovarian cancer, she was convinced that there was a hereditary link to breast cancer and continues to

call for the development of new tests to detect the gene.

King has worked with the Human Genome Diversity Project to examine why some early humans became ill when exposed to viruses or bacteria, while others did not. This research has been applied to her study of possible genetic reasons why some homosexual men who have been exposed to HIV develop AIDS, while others do not. She is the recipient of the Genetics Prize of the Peter Gruber Foundation (2004), the Heineken Prize for Medicine from the Royal Netherlands Academy of Arts and Sciences (2006), and the Weizmann Women & Science Award (2006). She has served on various committees of the National Cancer Institute, Institute of Medicine, Special Commission on Breast Cancer of the President's Cancer Panel, and National Institutes of Health (NIH). She was considered for the directorship of the NIH in 1991, but she declined this administrative position in order to focus on her research. She is a member of the American Society of Human Genetics and Society for Epidemiologic Research. She was elected to the National Academy of Sciences in 2005.

Further Resources

University of Washington. Faculty website. <http://www.gs.washington.edu/faculty/king.htm>.

Davies, Kevin and Michael White. 1996. *Breakthrough: The Race to Find the Breast Cancer Gene*. NY: John Wiley & Sons.

Klinman, Judith (Pollock)

b. 1941

Biochemist, Physical Organic Chemist

Education: B.A., chemistry, University of Pennsylvania, 1962, Ph.D., organic chemistry, 1966

Professional Experience: postdoctoral fellow, Isotope Department, Weizmann Institute of Science, Israel, 1966–1967; affiliate, chemistry, University College, London, 1967–1968; postdoctoral research associate, Institute for Cancer Research, Philadelphia, 1968–1972, assistant to associate member, 1972–1978; associate professor, chemistry, University of California, Berkeley, 1978–1982, professor, 1982–, professor, molecular and cell biology, 1993–

Concurrent Positions: assistant professor, medical biophysics, University of Pennsylvania, 1974–1978

Judith Klinman is renowned for bringing the principles and tools of physical organic chemistry to bear on biological processes. Her research has led to important breakthroughs in our understanding of protein function and structure, including the discovery of new cofactors (or vitamins) and the effect of oxygen on proteins. She also has been a leading figure in the use of isotope effects to probe enzymatic-reaction mechanisms and transition states.

After she received her doctorate, she was a postdoctoral fellow at the Weizmann Institute of Science in Israel and then was affiliated with the Department of Chemistry at the University College, London. First a postdoctoral associate at the Institute for Cancer Research in Philadelphia, she was promoted to research associate and later became an associate member there. Concurrently, she was assistant professor of biophysics at the University of Pennsylvania, where she taught and supervised graduate students. She joined the University of California, Berkeley in 1978 as an associate professor of chemistry and the first female faculty member in the physical sciences. She was promoted to full professor in 1982, and has held a joint appointment as professor of molecular and cell biology since 1993. Klinman is very active professionally, serving on the editorial board of scientific journals and giving lectures at universities and scientific organizations internationally.

In 1994, she was elected to the National Academy of Sciences and awarded the Repligen Award of the Division of Biological Chemistry of the American Chemical Society (ACS). She also received the Remsen Award of the ACS, a Merit Award from the National Institutes of Health (1992), and honorary doctorates from the University of Uppsala, Sweden (2000) and the University of Pennsylvania (2006). She has been named a fellow of the American Academy of Arts and Sciences, the Japanese Ministry of Science, and the American Philosophical Society. She is a member of the American Chemical Society, American Society of Biochemists and Molecular Biologists (president, 1998–1999), and Protein Society.

Further Resources

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

University of California, Berkeley. “Klinman Research Group.” <http://www.cchem.berkeley.edu/jukgrp/index.html>.

Knopf, Eleanora Frances Bliss

1883–1974

Geologist

Education: A.B., A.M., Bryn Mawr College, 1904; Ph.D., petrology, University of California, Berkeley, 1912; Johns Hopkins University, 1917–1918

Professional Experience: assistant curator, geology museum, Bryn Mawr College, 1904–1905, 1908–1909, demonstrator, geology laboratory, 1905–1906; aide, U.S. Geological Survey (USGS), 1912–1917, assistant geologist, 1917–1918, associate geologist, 1918–1928, geologist, 1928–1970

Concurrent Positions: geologist, Maryland Geological Survey, 1917–1920; research associate, department of earth sciences, Stanford University, 1951–1966

Eleanora Knopf introduced rock fabric analysis and structural petrology in the United States. She gained recognition for her work after publishing her methods in the book *Structural Petrology* (1938). In 1913, Knopf announced her discovery of the mineral glaucophane in Pennsylvania; this was the first sighting of the substance east of the Pacific coast. One of her most important projects was at Stissing Mountain, a region on the New York–Connecticut border. In the course of her studies for this project, she decided to use structural petrology in analyzing her data, which led to the publication of her book on the topic.

After she received her undergraduate degree at Bryn Mawr, studying with **Florence Bascom**, she continued working at the school in the geology museum and the geology laboratory. She received her doctorate from the University of California, Berkeley in 1912, and began working with the USGS, where she spent her entire career. The USGS hired women geologists on a contract basis, and Knopf accepted other work at times. She worked for the Maryland Geological Survey before her marriage, and she had a long-term association with the department of earth sciences at Stanford from 1951 to 1966, when her husband, Adolph Knopf, was a faculty member there. While at Stanford, she made studies of several locations in the Rocky Mountains in Montana and the Spanish peaks in Colorado. When she lived in New Haven, she was a visiting lecturer at Harvard and Yale, but she did not have formal appointments.

Knopf wrote a chapter on “The Geologist” for a 1920 guide to *Careers for Women* (edited by Catherine Filene). She was elected a fellow of the Geological Society of America, and was a member of the American Geophysical Union.

Kopell, Nancy J.

b. 1942

Applied Mathematician

Education: B.S., mathematics, Cornell University, 1963; Ph.D., mathematics, University of California, Berkeley, 1967

Professional Experience: instructor, mathematics, Massachusetts Institute of Technology (MIT), 1967–1969; faculty, Northeastern University, 1969–1986; professor, mathematics, Boston University, 1986–2000, William Goodwin Aurelio Professor of Mathematics and Science, 2000–

Concurrent Positions: visiting faculty, Centre National de la Recherche Scientifique, France 1970, MIT, 1975, 1976–1977, California Institute of Technology, 1976

Nancy Kopell is one of the few mathematicians working in the field of applied biomathematics. Her research uses mathematical models to analyze biological and neurophysiological features of neurons, networks of cells that are responsible for physical and cognitive functions such as motor skills, behaviors, perception, learning, and sensory processing. She studied math as an undergraduate at Cornell University at a time when there were few women in the discipline and received her doctorate in mathematics from the University of California, Berkeley in 1967. She taught at



Mathematician, Nancy Kopell. (Courtesy of BU Photo Services)

MIT and Northeastern before joining the faculty at Boston University in 1986, where she is also co-director of the Center for BioDynamics.

Kopell was elected to the National Academy of Sciences in 1996 for her work in systems neuroscience. She has held several prestigious grants and fellowships, including a Guggenheim fellowship and a five-year MacArthur “genius grant” (1990–1995). She has been an invited speaker and lecturer at numerous professional organizations and universities, and was named the John von Neumann Lecturer by the Society for Industrial and Applied Mathematics in 2007.

Further Resources

Boston University. Faculty website.
<http://cbd.bu.edu/members/nkopell.html>.

Case, Bettye Anne and Anne Leggett, eds.

2005. *Complexities: Women in Mathematics*. Princeton, NJ: Princeton University Press.

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

Koshland, Marian Elliott

1921–1997

Immunologist

Education: B.A., Vassar College, 1942; M.S., bacteriology, University of Chicago, 1943, Ph.D., immunology, 1949

Professional Experience: assistant, cholera project, Office of Scientific Research and Development, University of Chicago, 1943–1945; assistant, Commission on Air Borne Diseases, University of Colorado, 1943–1944; junior chemist, atomic bomb project, Manhattan district, Tennessee, 1945–1946; associate bacteriologist, Brookhaven National Laboratory, 1953–1962, bacteriologist, 1962–1965; associate

research immunologist, University of California, Berkeley, 1965–1969, research immunologist, 1969–1970, professor, bacteriology and immunology, 1970–1997

Concurrent Positions: fellow, bacteriology and immunology, Harvard University, 1949–1951; visiting professor, Cancer Center, Massachusetts Institute of Technology, 1980, 1985–1986

Marian Koshland was an immunologist who made important contributions to the study of disease. She became interested in science as a child after watching a younger brother suffer from typhoid fever. Koshland (known as “Bunny” to her family and colleagues) worked her own way through Vassar College and went on to earn a master’s degree from the University of Chicago in 1943. She had intended to go to medical school, but decided to pursue research while working at Chicago on a project to develop a cholera vaccine. This project was funded by the government in an effort to develop vaccines for soldiers serving overseas. She was also engaged in research to prevent respiratory infections and spent time at the University of Colorado on a World War II-era government project for the Commission on Air Borne Diseases. She had a contract assignment as a junior chemist with the Manhattan Project studying the effects of radiation before finally receiving her doctorate in immunology in 1949. She spent two years as a postdoctoral fellow at Harvard before returning to government work with the Brookhaven National Laboratory, where her husband, Daniel Koshland, was employed as a research scientist. When her husband accepted a position in California, she moved to the University of California, Berkeley as a researcher and then full-time professor of bacteriology and immunology. She made some of her most important scientific contributions early in her career while working only part-time and raising five children. She eventually published more than 200 articles.

Koshland was elected to the National Academy of Sciences in 1981. She was a member of the governing board of the National Science Foundation from 1976 to 1982 and was selected the R. E. Dyer Lecturer by the National Institutes of Health in 1988. She served on numerous boards and committees, including the National Institutes of Health, the National Science Board, and the National Council of the National Institute of Allergy and Infectious Diseases. She was a member of the American Association of Immunologists (president, 1982–1983), the Institute of Medicine, the American Society of Biological Chemists, and the American Academy of Microbiologists. She was a longtime member of the Board of Trustees for Haverford College in Connecticut, which has named its science research complex—the Marian E. Koshland Integrated Natural Sciences Center—in her honor. Haverford awarded her an honorary doctorate in 1995. In 2004, the Marian Koshland Science Museum of the National Academy of Science was established in Washington, D.C., with a gift from her husband.

Further Resources

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

Guyer, Ruth Levy. 2007. *Marian Elliot Koshland, 1921–1997: A Biographical Memoir*. Washington, D.C.: National Academy of Sciences.

Marian Koshland Science Museum. <http://www.koshland-science-museum.org>.

Kreps, Juanita (Morris)

b. 1921

Economist

Education: B.A., Berea College, 1942; M.A., Duke University, 1944, Ph.D., economics, 1948

Professional Experience: instructor, economics, Denison University, 1945–1946, assistant professor, 1947–1950; lecturer, Hofstra College, 1952–1954, and Queens College, 1954–1955; visiting assistant professor, economics, Duke University, 1955–1958, assistant to associate professor, 1958–1967, professor, 1967–1977, director, undergraduate economics studies and Dean of Women’s College, 1969–1972, vice president, Duke University, 1973–1977; Secretary of Commerce, U.S. Department of Commerce, 1977–1979

Juanita Kreps is an economist focused on women’s employment and was the first woman Secretary of Commerce of the U.S. Department of Commerce. She was also the first professional economist to hold that cabinet post. Prior to that time, the Secretaries had supported the interests of business, but she stated that she would support the interests of the public, including consumers, as well as those of business. The late 1970s was a period of high unemployment owing to the restructuring of industries, and corporations were experiencing increased competition from abroad in industries such as steel and automobiles, traditionally the strong sectors of U.S. industry. While she was working to revitalize industry, she was also working to increase social consciousness among businesspeople.

Kreps specialized in labor demographics with particular emphasis on the employment of women and older workers. In *Sex in the Marketplace: American Women at Work* (1971), she explored such questions as why women enter into the same types of occupations, why their proportion of advanced degrees remains so low, and why so many exchange the monotony of housework for equally dull and low-paying office and factory jobs. Another book, *Sex, Age, and Work: The Changing Composition of the Labor Force* (1975), explored the effect of women’s increased presence in

the workplace. In 1975, she organized a conference called “Women and the American Economy” that produced a statement endorsing the Equal Rights Amendment, recommending stronger affirmative action programs at universities, and urging public education for preschool children.

Kreps was born in a coal-mining region of Kentucky and grew up during the Great Depression. She worked her way through college on a work-study program. She decided to major in economics after her first class in the subject because it seemed especially relevant to her situation. As a highly respected economist, Kreps attracted attention from leading corporations that were under pressure in the early 1970s to add women to their boards of directors. She was named to the board of the New York Stock Exchange plus the boards of several companies such as Western Electric and Eastman Kodak. After she completed her term as Secretary of the Department of Commerce, she continued to write and lecture, and she served on many committees and commissions. She is a fellow of the Gerontological Society of America and of the American Academy of Arts and Sciences, and a member of the American Economic Association.



Economist Juanita Kreps served as Secretary of Commerce under President Jimmy Carter from 1977 to 1979. (Department of Commerce)

Krim, Mathilde (Galland)

b. 1926

Geneticist, Virologist

Education: B.S., genetics, University of Geneva, Switzerland, 1948, Ph.D., cytogenetics, 1953

Professional Experience: junior scientist and research associate, Weizmann Institute, Israel, 1953–1959; research associate, virology, Division of Virus Research, Cornell University Medical College, 1959–1962; associate, Sloan-Kettering Institute of Cancer Research, 1962–1975, associate and member, 1975–1986; associate

research scientist, St. Luke's Roosevelt Hospital Center and College of Physicians and Surgeons, New York City, 1986–

Concurrent Positions: adjunct professor, public health and management, Columbia University; founder and co-chair, American Foundation for AIDS Research (amfAR), 1985, chair, 1990–2004

Mathilde Krim is a distinguished geneticist and virologist who, since the 1980s, has devoted her time to raising funds for AIDS research. While working at the Sloan-Kettering Institute for Cancer Research on cancer viruses, she became intrigued with the possibility that the protein interferon, which is produced naturally by almost all animal species and even some plants, might inhibit tumors and modify some properties of the immune system in animals. She felt this would be a significant area of research, particularly in 1974, when a Swedish physician announced some success with interferon's stopping the recurrence of highly malignant bone cancer in a number of patients. She pressed Sloan-Kettering to establish an interferon laboratory

and also sought funding from the National Institutes of Health and the National Cancer Institute. When the results of the Swedish tests were discredited, there was great controversy over the efficacy of interferon, which was very expensive as a natural substance. After a researcher cloned the interferon gene, it was possible to produce interferon in large quantities, and Krim was then appointed as head of Sloan-Kettering's interferon evaluation program; the Institute won Food and Drug Administration (FDA) approval to use interferon to treat certain types of leukemia.

Krim initially became involved in AIDS research through studies of the effectiveness of interferon in treating Kaposi's sarcoma, a cancer that afflicts many AIDS patients. She realized that the funding for AIDS research was inadequate, and in 1983, she founded the AIDS Medical Foundation, later merged with another



Mathilde Krim at a benefit for amfAR, the American Foundation for AIDS Research, in New York, 2007. (AP/Wide World Photos)

group to form the American Foundation for AIDS Research; amfAR is now the largest nonprofit AIDS research organization, funding all areas including gene therapy, prevention, drug treatments, and public-policy initiatives. Krim was able to unite the scientific and entertainment communities through her husband, the founder of Orion Pictures, and celebrity spokespersons such as actress Elizabeth Taylor helped raise public awareness about AIDS and the efforts of amfAR. In recent years, Krim has also focused on another health threat, multidrug-resistant tuberculosis (MDRTB), which is a serious problem among people who are HIV-positive as well as the homeless, people in prison, and the poor.

Krim has been a member of the Committee of 100 for National Health Insurance and president of the Commission to Study Ethical Problems in Medical, Biomedical, and Behavioral Research. She is a member of the American Association for the Advancement of Science, American Cancer Society, and American Association on Mental Deficiency. She was awarded the Presidential Medal of Freedom in 2000 by President Clinton in recognition of her “extraordinary compassion and commitment.”

Further Resources

amfAR Aids Research. <http://www.amfar.org>.

Krueger, Anne (Osborn)

b. 1934
Economist

Education: B.A., economics, Oberlin College, 1953; M.S., University of Wisconsin, 1956, Ph.D., economics, 1958

Professional Experience: instructor, economics, University of Wisconsin, Madison, 1958–1959; assistant to associate professor, economics, University of Minnesota, 1959–1966, professor, 1966–1982; vice president, economics and research, World Bank, Washington, D.C., 1982–1986; professor, economics, Duke University, 1987–1993; professor, economics, Stanford University, 1993–2001; First Deputy Managing Director, International Monetary Fund, 2001–2006; professor, international economics, Johns Hopkins University, 2007–

Anne Krueger is an economist with expertise in international trade and economic development. She has been involved in developing international economic policy as a vice president and consultant for the World Bank and director of the International Monetary Fund from 2001 to 2006. She has been a longtime member or consultant on a variety of government and academic councils, including the

National Bureau of Economic Research, Institute for Global Economics, and Center for Policy Studies. While a professor of economics at Stanford, she was also director of the Center for Research on Economic Development and Policy Reform. She has authored, co-authored, or edited more than 15 books on trade, development, economic change, developing countries, exchange rates, and economic aid. The National Bureau of Economic Research sponsored her three-volume *Trade and Employment in Developing Countries* (1983; 2nd ed., 1988), and her other books include *Political Economy of Policy Reform in Developing Countries* (1994), *American Trade Policy: A Tragedy in the Making* (1995), *The World Trade Organization as an International Organization* (2000), *Transforming India's Economic, Financial and Fiscal Policies* (co-author, 2003), *Latin American Macroeconomic Reform: The Second Stage* (co-author, 2003), and *Economic Policy Reform and the Indian Economy* (2003).

Krueger was elected to membership in the National Academy of Sciences in 1995. Due to her international reputation, she has received honorary doctorates from Hacettepe University in Turkey (1990), Georgetown University (1993), Monash University in Melbourne, Australia (1996), and Chinese University of Hong Kong (2003). Among the other honors she has received are the Robertson Prize of the National Academy of Sciences (1984), Bernhard-Harms Prize of the Kiel Institute of World Economics (1990), Kenan Enterprise Award of the Kenan Charitable Trust (1990), and Frank E. Seidman Distinguished Award in Political Economy (1993). She is a fellow of the American Academy of Arts and Sciences and the Econometric Society, and a member of the American Economic Association (vice president, 1977–1978; president, 1996) and the Royal Economic Society.

Further Resources

Johns Hopkins University. Faculty website. <http://www.sais-jhu.edu/faculty/krueger/index.htm>.

Kübler-Ross, Elisabeth

1926–2004

Psychiatrist

Education: M.D., University of Zurich, 1957

Professional Experience: intern, Community Hospital, Glen Cove, New York, 1958–1959; research fellow, Manhattan State Hospital, 1959–1962; fellow, psychiatry, Psychopathic Hospital, University of Colorado Medical School, 1962–1963, instructor, psychiatry, Colorado General Hospital, 1962–1965; assistant

professor, psychiatry, Billings Hospital, University of Chicago, 1965–1970, assistant director, Psychiatric Consultation and Liaison Service, 1965–1969, acting chief, Psychiatric Inpatient Service, 1965–1966, associate chief, Psychiatric Inpatient Service, 1966–1967; medical director, Family Service and Mental Health Center, South Cook County, Illinois, 1970–1973; president, Ross Medical Associates, 1973–1976; president and chair of the board, Shanti Nilaya Growth and Health Center, Escondido, California, 1977–1995; founder and president, Elisabeth Kübler-Ross Center, Virginia, 1990–1995

Concurrent Positions: resident, Montefiore Hospital, 1961–1962; staff member, LaRabida Children’s Hospital and Research Center, Chicago, 1965–1970; clinical professor, Behavioral Medicine and Psychiatry, University of Virginia, 1985

Elisabeth Kübler-Ross was a psychiatrist who challenged the taboos surrounding death in our culture. She pioneered a new field of healthcare, “thanatology,” the study of the effects of death and dying, especially the investigation of ways to lessen the suffering and address the needs of the terminally ill and their survivors. While teaching psychiatry courses in the 1960s, Kübler-Ross ran a series of conversations with the terminally ill in order to assess their feelings about the process of dying. She pointed out that treatment of the dying had changed over time, from taking place at home in the comforting presence of family and friends to occurring in impersonal institutional settings where death is seen as a failure of the technological expertise of physicians, who wish to prolong life. In her landmark book, *On Death and Dying* (1969), she identified the five stages that dying patients experience—denial, anger, bargaining, depression, and acceptance—and her work paved the way for the more humane treatment of the terminally ill by medical personnel. Hospice care was established as an alternative to dying in hospitals, and more emphasis was put on the emotional needs of patients and their families. The rights of terminally ill patients, however, have been the topic of much debate in recent years around the issue of assisted suicide.

After *Life* magazine published an article about her work, Kübler-Ross gained public attention and began receiving invitations to speak at seminars throughout the United States and Canada. She also continued to see patients and their families in her regular practice. Her book *AIDS: The Ultimate Challenge* (1987) was written for those suffering from the disease and focused on the medical, moral, and social implications of AIDS. She was committed to working with the patients directly and, in 1977, she created a center for the terminally ill and their families called “Shanti Nilaya” (Home of Peace) in Escondido, California, which continues her work to this day. She also operated the Elisabeth Kübler-Ross Center in Virginia to train those working professionally with the terminally ill, and co-founded the American Holistic Medical Association.

She received numerous honorary degrees and was a member of the American Association for the Advancement of Science, American Holistic Medical Association, American Medical Women's Association, American Psychiatric Association, and American Psychosomatic Society. She published numerous books, including her autobiography, *The Wheel of Life: A Memoir of Living and Dying* (1997), in which she claimed she had out-of-body experiences, meetings with spirit guides, and visions of fairies. An earlier biography was published by Derek Gill entitled *Quest: The Life of Elisabeth Kübler-Ross* (1980).

Further Resources

Elisabeth Kübler-Ross. <http://www.elisabethkublerross.com/>.

Kuhlmann-Wilsdorf, Doris

b. 1922

Physicist, Metallurgist

Education: B.S., materials science, University of Göttingen, 1944, M.S., physics, 1946, Ph.D., materials science, 1947

Professional Experience: fellow, materials science, University of Göttingen, 1947–1948; fellow, physics, Bristol University, England, 1949–1950; lecturer, physics, University of Witwatersrand, Johannesburg, 1950–1956; associate professor, metallurgy, University of Pennsylvania, 1957–1961, professor, 1962–1963; professor, engineering physics, University of Virginia, 1963–1966, professor, physics and metallurgical science, 1966–2005

Concurrent Positions: visiting professor, physics, Pretoria University, 1982–1983

Doris Kuhlmann-Wilsdorf is a metallurgist and materials scientist renowned for her design for electrical metalfiber brushes to be used as sliding electrical contacts. She holds patents on six inventions related to the electrical brushes. The brushes have application in electric motors that could replace the heavier and less efficient diesel engines. Her area of expertise is called *tribology*, which is the study of the effects of friction on moving machine parts and of methods of lubrication. Another of her contributions is the development of a model for surface deformation, which takes into account erosion as well as friction and wear. She has also investigated the behavior and properties of various metals, such as studying why rolled aluminum sheets crinkle under pressure, while other sheet metals break.

Prior to entering college in Germany, she served as an apprentice metallographer and materials tester for two years. After receiving her doctorate from Göttingen,

she continued her research and studied under Nobel Laureate Nevill F. Mott. She and her husband, Heinz G. F. Wilsdorf, came to the United States and eventually both received appointments at the University of Virginia as professors in the Physics and Materials Science Departments. In 1994, the Wilsdorfs funded a professorship in their name, and in 2001, a gift from one of Doris Kuhlmann-Wilsdorf's former students established a memorial building on campus in their name.

Kuhlmann-Wilsdorf has published over 250 scientific papers and has served as a consultant to corporations such as General Motors Technical Center, Chemstrand Research Laboratories, and General Dynamics Corporation, as well as for the National Institute for Standards and Technology. She was elected to membership in the National Academy of Engineering in 1994. She has received numerous honors and awards, including the Society of Women Engineers Achievement Award (1989), Ragnar Helm Scientific Achievement Award of the Institute of Electrical and Electronics Engineers (1991), Medal for Excellence in Research of the American Society of Engineering Education (1965 and 1966), and Heyn Medal of the German Society of Materials Science (1988), and was named Christopher J. Henderson Inventor of the Year by the University of Virginia Patent Foundation in 2001 and 2006 Fellow of TMS-AIME (the Minerals, Metals, and Materials Society and the American Institute of Mining, Metallurgical, and Petroleum Engineers). She is also a fellow of the American Society for Metals and the American Physical Society, and a member of the American Society of Mechanical Engineers and Society of Women Engineers.

Kurtzig, Sandra L. (Brody)

b. 1946

Computer Scientist, Aeronautical Engineer

Education: B.S., chemistry and mathematics, University of California, Los Angeles, 1968; M.S., aerospace engineering, Stanford University, 1968

Professional Experience: mathematical analyst, TRW Systems, 1967–1968; marketing representative, General Electric Corporation, 1969–1972; president and CEO, ASK Computer Systems, 1972–1993; co-founder, eBenefits, 1996–

Sandra Kurtzig is a computer pioneer who founded ASK Computer Systems in 1972, the largest public company founded by a woman and one of the biggest success stories of the 1970s minicomputer boom. The company's integrated software products for manufacturers, primarily its MANMAN Information System, are industry standards and are available as turnkey solutions for minicomputers,

particularly those manufactured by Digital Equipment and Hewlett-Packard. In the 1990s, Kurtzig expanded the product line by developing portable applications software to run on multiple computer platforms and adapted the software to specific niche markets, such as the automotive industry. Kurtzig was a young mother when she started ASK out of her apartment with only a \$2,000 investment. The name of the company was derived from her and her husband's initials—Arie and Sandra Kurtzig. She started developing innovative programs for businesses, such as one for a newspaper company to monitor its carriers, and later created minicomputer programs and information systems to help manufacturers optimize inventory, improve product quality, reduce operating expenses, and improve customer service. She had the foresight to design software to run on minicomputers when they were just starting to become popular.

In 1994, her company was purchased by Computer Associates International for \$310 million. She has since formed an online business software consulting firm with her son. Kurtzig's autobiography, *CEO: Building a \$400 Million Company from the Ground Up* (1991), describes her experiences starting and running a successful business in a male-dominated field. She was one of only a few women studying math and aeronautical engineering in college, and she has rarely encountered other women in manufacturing companies or in upper management.

Kwolek, Stephanie Louise

b. 1923

Polymer Chemist

Education: B.S., chemistry, Carnegie Institute of Technology, 1946

Professional Experience: chemist, Fibers Department, Experimental Station, E. I. Du Pont de Nemours and Company, 1946–1959, research chemist, 1959–1967, senior research chemist, 1967–1974, research associate, 1974–1986; consultant, E. I. Du Pont de Nemours and Company, 1986–

Stephanie Kwolek invented a polymer that is manufactured by Du Pont under the trade name Kevlar. After graduating from college, she took what was supposed to be a temporary job at Du Pont while saving money to attend medical school. Her work was so interesting, however, that she stayed on with the company and became involved in the research that led to the discovery of low-temperature polymerization. She gained national attention in 1960 for her work creating long molecule chains at low temperatures and her discovery of the method to spin synthetic, petroleum-derived fibers in a liquid crystalline solution. The compound had

such high tensile strength that she ran the tests again and again to make sure she had not made an error before reporting her discovery to the laboratory director. The resulting product, Kevlar, eventually led to a multimillion-dollar industry with more than 200 commercial applications, including use in radial tire cords, composites, rope, thermal insulating clothing, and bulletproof vests. At the time of her retirement, Kwolek owned 17 U.S. patents.

The use of Kevlar in bulletproof vests has earned Kwolek many fans and accolades. More than 2,000 police officers whose lives were saved due to wearing Kevlar vests formed a Survivors Club, a joint venture between Du Pont and the International Chiefs of Police Association. Kwolek is regularly contacted by individuals thanking her and even asking for an autograph. Even after her retirement, Kwolek continues to consult with Du Pont, as well as to give public and school lectures about careers in science. In 1996, she was featured along with other Du Pont employees in a series of print and television ads describing the company's research.

Kwolek was elected to the National Academy of Engineering in 2001 for "the discovery, development, and liquid-crystal processing of high-performance aramid fibers." She won an early publication prize from the American Chemical Society (1959), and has also received the Creative Invention Award of the ACS (1980) and the Perkin Medal of the Society of Chemical Industry (1997), only the second woman to receive that prize. She was inducted into the National Inventors Hall of Fame (1995) and the Women in Technology International (WITI) Hall of Fame (1996), and has received the nation's highest technology honor, the National Medal of Technology (1996). She has received honorary doctorates from Worcester Polytechnic Institute (1981) and from the University of Delaware (2008). She is a member of the American Chemical Society and American Institute of Chemists.



LaBastille, Anne

b. 1938

Ecologist

Education: B.S., conservation, Cornell University, 1955; M.S., wildlife management, Colorado State University, 1958; Ph.D., wildlife ecology, Cornell University, 1969

Professional Experience: wildlife tour leader, National Audubon Society, Palm Beach, Florida, 1955–1956; organizer and co-leader, Caribbean Wildlife Tours, Miami, Florida, 1956–1963; owner, co-manager, and naturalist, Covewood Lodge, Big Moose, New York, 1956–1964; ranger-naturalist, Everglades National Park, Florida, 1964; assistant professor, Department of Natural Resources, Cornell University, 1969–1971, research associate, Laboratory of Ornithology, 1971–1973; freelance wildlife ecologist, consultant, writer, and photographer, 1971–

Concurrent Positions: commissioner, Adirondack Parks Agency, 1976–1993; visiting lecturer and Basler Chair of Excellence for the Integration of the Arts, Rhetoric and Science, East Tennessee State University, 2001; owner, West of the Wind Publications, Eagle Bay, New York

Anne LaBastille is an ecologist who has fulfilled a variety of roles in support of wilderness conservation. She has done extensive work on preserving the wildlife habitat of several species of birds, including a project with a flightless bird known as the giant pied-billed grebe that was found at only one large lake in Guatemala. There was little known about this water bird until she began the first systematic study of its characteristics, and no photographs or drawings of it had ever been made. She established a sanctuary for the birds and monitored the population, obtaining grants from the World Wildlife Fund and the Smithsonian Institution to support her work. She persuaded the Guatemalan government to designate the grebe's habitat as the country's first wildlife refuge, but even so, the population dwindled. She published two early books on the folklore of birds, *Birds of the Mayas* (1964) and *Bird Kingdom of the Mayas* (1967). The local people called her "Mama Poc," based on the Indian name for the grebe, and she recorded her experiences in her book *Mama Poc: Story of the Extinction of a Species* (1990).



Ecologist Anne LaBastille has written numerous books and articles on wildlife and wilderness conservation. (AP/Wide World Photos)

After receiving her undergraduate degree from Cornell University, LaBastille spent her summers conducting wildlife tours in Florida and winters operating a lodge in upstate New York while working on her master's degree at Colorado State University. She returned to Cornell to obtain her doctorate and worked as a research associate in the internationally known Laboratory of Ornithology at Cornell while she started working freelance as a wildlife ecologist, writer, and photographer for organizations such as *National Geographic*. She has lived alone in two cabins she built in the upstate forestland of New York and is best known for her four-part autobiographical series describing her life among the plant and animal life in the Adirondacks: *Woodswoman* (1976), *Woodswoman II* (1987), *Woodswoman III* (1997), and *Woodswoman IV* (2003).

Her book, *The Wilderness World of Anne LaBastille* (1993), consists of selections from never-before-published poems and short stories as well as color photographs. In *Women and Wilderness* (1980), she examines the historical role of other women living and studying in wilderness, including scientists such as **Eugenie Clark**, Jane Goodall, and others employed as park rangers, marine and wildlife biologists, professional environmentalists, or naturalists.

LaBastille's writings and activism have earned her the devotion of fans, both local and international. She has been a wilderness guide as well as an invited lecturer at universities and conservation groups. Her many awards and honors include a World Wildlife Fund Gold Medal (1974), Literature Award of the New York State Outdoor Education Association (1977), Citation of Merit from the Explorers Club (1987), Chevron Conservation Award (1988), Jade Chief's Award of the Outdoors Writer Association of America, and research grants from the International Union for Conservation of Nature and Natural Resources, Caribbean Research Institute, World Wildlife Fund, Smithsonian Institution, and other agencies. She has been a member of the Society of Women Geographers, American Women in

Science, Association for Tropical Biology, Wildlife Society, Outdoor Women Writers of America, and Explorer's Club.

Further Resources

Holmes, Madelyn. 2004. *American Women Conservationists: Twelve Profiles*. Jefferson, NC: McFarland.

Ladd-Franklin, Christine

1847 1930

Psychologist

Education: A.B., mathematics, Vassar College, 1869; Ph.D., mathematics, Johns Hopkins University, 1926; University of Göttingen, 1891–1892; University of Berlin, 1892, 1894, 1901

Professional Experience: high school teacher, 1869–1878; lecturer, psychology and logic, Johns Hopkins University, 1904–1909; lecturer, psychology and logic, Columbia University, 1914–1927

Christine Ladd-Franklin was one of the foremost women psychologists of the early twentieth century. Her research interests included color vision, deductive reasoning, the doctrine of histurgy, the one-time one-place theory of judgment, and proof that a nerve when stimulated emits physical light. Although she published papers on symbolic logic, her primary contribution to the history of psychology is her emphasis on the evolutionary development of increased differentiation in color vision, known as the Ladd-Franklin color theory. She published a compilation of her papers in *Colour and Colour Theories* (1929) and was invited to contribute an appendix to the English translation of Hermann von Helmholtz's classic *Handbook of Physiological Optics* (1924).

Ladd-Franklin studied mathematics at Vassar because there were no laboratory facilities available for study in physics. After she graduated in 1869, she taught high school science for 10 years, during which time she published articles on mathematics in the British journal *Educational Times* and the American journal *Analyst*. Originally denied admission to graduate study due to her sex, she was eventually admitted to Johns Hopkins University on a fellowship due to the recommendation of a mathematics professor who had read her papers. Although she fulfilled the requirements for a Ph.D. by 1882 with a thesis on "The Algebra of Logic," the trustees refused to grant the degree to a woman, as was the custom at that time; she finally received the degree in 1926. Still, even without the formal



Psychologist and mathematician Christine Ladd-Franklin. (National Library of Medicine)

degree, she held a lectureship in logic and psychology at Johns Hopkins from 1904 to 1909. In 1882, she married Fabian Franklin, a member of the mathematics department, and the couple moved to New York City in 1910 when he was appointed to an associate newspaper editor position. She spent the remainder of her career lecturing on logic and psychology at Columbia University.

Ladd-Franklin was a strong supporter of higher education, and she was instrumental in establishing research fellowships and even giving her money directly to women scientists who needed funds for research or travel. She published newspaper articles and editorials on women's education and status. Vassar College awarded her an honorary degree in 1887. She was a member of the American Association for the Advancement

of Science, the American Society of Naturalists, the American Psychological Association, the Optical Society of America, and the American Philosophical Association.

Further Resources

Scarborough, Elizabeth and Laurel Furumoto. 1987. *Untold Lives: The First Generation of American Women Psychologists*. New York: Columbia University Press.

Laird, Elizabeth Rebecca

1874–1969

Physicist

Education: B.A., University of Toronto, 1896; Ph.D., physics and mathematics, Bryn Mawr, 1901

Professional Experience: instructor, mathematics, Ontario Ladies' College, 1896–1897; assistant, physics, Mount Holyoke College, 1901–1902, instructor,

1902–1903, acting head, 1903–1904, professor, 1904–1940; physicist, radar development, University of Western Ontario, 1941–1945, honorary professor of physics, 1945–1953

Concurrent Positions: Cavendish Laboratory, Cambridge University, 1909; physics laboratory, University of Chicago, 1919; honorary research fellow, Yale University, 1925

Elizabeth Laird was regarded as a notable physicist who spent most of her career teaching at Mount Holyoke College. Her research interests included spectroscopy, thermal conductivity, spark radiation, soft x-rays, the Raman effect, and electrical properties of biological material in the microwave region.

A native of Canada, she received her undergraduate degree at the University of Toronto, where she was awarded honors and fellowships in mathematics and physics. Denied a scholarship reserved for men to continue their graduate studies, she instead taught math for two years at an Ontario women's college before applying for admission at Bryn Mawr in Pennsylvania. For her research, she received a physics fellowship to work at the University of Berlin and received the doctorate in physics and mathematics from Bryn Mawr in 1901. She immediately joined the faculty of Mount Holyoke College, advancing very quickly in three years from instructor to professor. She stayed at Mount Holyoke for 40 years, training an entire generation of young women in the sciences. During World War II, she returned to Canada, where she spent four years as a physicist in radar development at the University of Western Ontario and also taught radio techniques for the Royal Canadian Air Force. Even after she officially retired, she continued her research on microwave radiation until at least 1953 as an honorary professor. She received honorary degrees from the University of Toronto (1927) and the University of Western Ontario (1954).

Laird was elected a fellow of the American Physical Society and was a member of the American Association for the Advancement of Science, the Optical Society of America, the American Association of Physics Teachers, the Canadian Association of Physicists, and the History of Science Society. She received several awards and honors. She received the American Association of University Women Sarah Berliner Research fellowship for study at the University of Wurzburg (1913–1914).

La Monte, Francesca Raimond

1895–1982
Ichthyologist

Education: B.A. and certificate of music, Wellesley College, 1918

Professional Experience: secretary, Department of Ichthyology, American Museum of Natural History, 1919–1923, 1925–1928, staff assistant, Department of Fishes and Aquatic Biology, 1928–1929, assistant curator, 1929–1935, associate curator, 1935–1962

Francesca La Monte was recognized for her work as an ichthyologist at the American Museum of Natural History. Her primary interests were marlin and swordfish (she participated in big-game fishing as a hobby), and she developed exhibits at the museum on these and other species. Soon after receiving her undergraduate degree from Wellesley, she joined the museum and she rose through the ranks to become associate, curator, retiring in 1962. It was not unusual for a woman to be appointed curator of a museum. In the nineteenth century, many women worked with fathers, husbands, or brothers as underpaid or unpaid staff in museums, arboreta, and herbaria; these positions sometimes evolved into paid professional jobs. La Monte was a specialist in taxonomic ichthyology and a valued member of the staff at the American Museum of Natural History. She was a member of the museum's Lerner-Cape Breton expeditions of 1936 and 1938, the Lerner-Bimini expedition of 1937, and the Chile-Peru expedition of 1940. She was a member of the fisheries committee for the 1939–1940 World's Fair in New York City. At the museum, she worked on the *Bibliography of Fishes* and, having grown up in Russia and England and also having spent time in France, Italy, and Germany as a child, she was able to translate numerous documents for the American bibliography as well as articles for an English-speaking audience. She was the museum's delegate to the International Zoological Congress in Padua, Italy in 1930, one of only five representatives from U.S. institutions.

La Monte was co-editor of *Field Book of Fresh Water Fishes of North America* (1938), *Game Fish of the World* (1949), and *The Fisherman's Encyclopedia* (1950). She was co-author of *Vanishing Wilderness* (1934) and author of *North American Game Fishes* (1945), *Marine Game Fishes of the World* (1952), and *Giant Fishes of the Ocean* (1966). She was elected a fellow of the New York Academy of Sciences. Her other professional memberships included the American Association for the Advancement of Science, the American Society of Ichthyologists and Herpetologists, and the Society of Systematic Zoology.

Further Resources

Brown, Patricia Stocking. 1994. "Early Women Ichthyologists." *Environmental Biology of Fishes*. 41:9–30. <http://swfsc.noaa.gov/uploadedFiles/Education/Women%20in%20Ichthyology.pdf>.

Lancaster, Cleo

b. 1948

Physiologist

Education: B.S., Elizabeth City State University, 1971; M.S., biomedical science, Western Michigan University, 1979

Professional Experience: research assistant, Brookhaven National Laboratory, 1971; research associate, Upjohn Company, 1971–1989, senior research associate, pharmacology, 1989–

Cleo Lancaster is a pioneer in biological research leading to new ulcer therapies and an expert in the field of prostaglandin cytoprotection, which is the cellular protection of the gastric lining by the use of hormonelike fatty acids. At Upjohn Company (later acquired by Pfizer), she has developed experimental models of such gastrointestinal diseases as ulcers, diarrhea, pancreatitis, and colitis in order to discover natural or synthetic chemicals to treat such conditions. In the early 1970s, she studied the ulcer-causing effects of nicotine and linked smoking to duodenal ulcers in humans. She has examined the effects of ibuprofen, aspirin, and alcohol as irritants to the gastrointestinal tract, and she has also examined a steroid used in organ transplant patients that causes ulcers. Her research revealed that fatty acids known as prostaglandins can be used to inhibit gastric acid secretion by stimulating mucus/bicarbonate production and increasing the cell resistance of the stomach lining, thus preventing ulcers. She holds two patents: one for a treatment of pancreatitis and the second for treating ulcers with oxalate derivatives. She also contributed to developing surgical techniques for the research of gastric secretion.

Lancaster grew up on a farm learning about anatomy and veterinary science from working with animals. She originally planned to be a biology teacher, but in her third year of college, she decided on a career in research because she wanted the challenge of discovery. She worked as a research assistant in radiation genetics the summer after she received her undergraduate degree, and she joined the Upjohn Company in the fall as a research associate in gastrointestinal, or ulcer, research. She received her master's degree in biomedical science from Western Michigan University while working for Upjohn. She received the Laboratory Special Recognition Award of the Upjohn Company and the Mary McLeod Bethune Award for Science and Technology. She is a member of the American Association for the Advancement of Science and the New York Academy of Sciences.

Lancefield, Rebecca Craighill

1895–1981

Bacteriologist

Education: A.B., Wellesley College, 1916; A.M., Columbia University, 1918, Ph.D., immunology and bacteriology, 1925

Professional Experience: high school teacher, 1917; technical assistant, Rockefeller Institute, 1918–1919; department of genetics, Carnegie Institution, 1919–1921; instructor, bacteriology, University of Oregon, 1921–1922; technical assistant, Rockefeller Institute, 1922–1929, associate, 1929–1958, professor, microbiology, 1958–1965

Rebecca Lancefield was recognized among microbiologists as the outstanding authority on streptococci. Her research was in immunochemical studies of streptococci, and the chemical composition and antigenic structure of hemolytic streptococci. Both national and international organizations devoted to streptococcal problems have renamed their groups the Lancefield Society in her honor. While she was attending Wellesley College, she became interested in the biology course her roommate was taking, and she switched her major from French and English to biology. She was able to receive a scholarship offered specifically for daughters of Army and Navy officers to attend Columbia University. Lancefield obtained a position as a technical assistant at the Rockefeller Institute for Medical Research, working on streptococci. The group identified four distinct serological types that served to classify 70% of the 125 strains studied; her name was included as a co-author of the paper reporting this work, a distinct honor so early in her career.

After teaching for a year at the University of Oregon, she and her husband returned to Rockefeller, where Lancefield remained the rest of her career. She worked with rheumatic fever research and received her doctorate in 1925. She returned to her studies of hemolytic streptococci, in which she provided a basis for understanding the clinical and epidemiological patterns of disease caused by these organisms. The research at that time was concentrated on puerperal fever, wound infections, and pneumonia that followed measles or influenza. Later research involved scarlet fever and rheumatic fever. In the mid-1920s, she succeeded in obtaining two antigens in soluble form from hemolytic streptococci, one that was type-specific and one that was species-specific. She continued her research on streptococci until a few months before her death in 1981.

Lancefield was elected a member of the National Academy of Sciences in 1970. Among the other honors and awards she received were the Jones Memorial Award of the Helen Hay Whitney Foundation (1960), the Research Achievement Award of the American Heart Association (1964), and the Medal of the New York

Academy of Medicine (1973). As further recognition within the field, she was elected president of the American Society for Microbiology in 1943, the second woman to be elected president of the organization, and served as the first woman president of the American Association of Immunologists in 1961 and 1962. She also was a member of the American Association for the Advancement of Science and the Harvey Society. She received honorary degrees from the Rockefeller Institute (1973), and from Wellesley College (1976) on the sixtieth anniversary of her graduation.

Leacock, Eleanor (Burke)

1922 1987

Cultural Anthropologist

Education: student, Radcliffe College, 1939–1942; B.A., Barnard College, 1944; M.A., Columbia University, 1946, Ph.D., anthropology, 1952

Professional Experience: research assistant, psychiatry, Cornell University Medical College, 1952–1955; lecturer, anthropology and sociology, Queens College, 1955–1956; special consultant, U.S. Department of Health, Education, and Welfare, 1957–1958; co-director of research, suburban interracial housing, Teaneck, New Jersey, 1958–1960; senior research associate, schools and mental health project, Bank Street College of Education, 1958–1965; lecturer, history and economics, Polytechnic Institute of Brooklyn, 1962–1963, associate professor to professor, anthropology, 1963–1972; professor, anthropology, City College of New York, 1972–1987

Concurrent Positions: lecturer, City College of New York, 1956–1960, 1966–1967, and Washington Square College, 1960–1961

Eleanor Leacock was a prominent cultural anthropologist known for her studies of the changing social and gender relations among the natives of Labrador, her reevaluations of the work of the Marxist Friedrich Engels, her contributions to feminist theory, and her analyses of racism in American education. When she accompanied her first husband, a filmmaker, to Europe in 1948, she began archival research on changes in the social organization of an Indian people in Labrador, the Montagnais-Naskapi (Innu), following the introduction of the fur trade. The next year, she started her field research in Labrador, and her research changed the prevailing interpretation of private property in hunter-gatherer societies. She found that although the rights to trap in given places were privatized, the rights to gather, fish, or hunt for food were still communal. It had been thought that these societies

were patriarchal, but she found that there was flexibility in the relations between women and men. She recorded stories that the residents told her, typed them, and presented them to the tribes.

Leacock was exposed to radical social theories early in life, for her father was a literary critic and social philosopher whose social circle included artists, political radicals, and writers in Greenwich Village. As a college student, she was active in student radical groups, and when she applied for a job in Washington, D.C., in 1944, the Federal Bureau of Investigation denied her clearance. She held various research and teaching positions before becoming a professor of anthropology and achieved recognition for her work on anthropology and education, on class and culture in urban schools, and on reevaluating the work of early Marxists. She published more than 70 papers and books before dying unexpectedly in Honolulu in 1987 after suffering a stroke in Western Samoa, where she was conducting field-work. She was a fellow of the American Anthropological Association and the Society for Applied Anthropology, and a member of the American Ethnological Society.

Further Resources

Gacs, Ute et al. 1988. *Women Anthropologists: Selected Biographies*. Westport, CT: Greenwood Press.

Leavitt, Henrietta Swan

1868–1921

Astronomer

Education: Oberlin College, 1885–1886; A.B., Radcliffe College, 1892

Professional Experience: volunteer research assistant, Harvard College Observatory, 1895–1900, staff member, 1902–1921

Henrietta Leavitt discovered the period-luminosity law, that is, the relation between a star's magnitude and its period of luminosity. This work involved determining the magnitude (brightness) of a star from a photographic image. At the turn of the century, visual photometry was superseded by photographic methods because the photographic plate is more sensitive to light of certain wavelengths than is the human eye. Another of her contributions to astronomy was the discovery of 2,400 variable stars, about half of the total known at the time. Her most important scientific contribution resulted from her study of the Cepheid variable stars in the Magellanic Clouds. She also studied color indices, which is the

difference in magnitude of a star depending on the color-sensitivity of photographic plates.

Born in Massachusetts, she began her college studies in music at Oberlin College in Ohio. She moved to Radcliffe College in 1888, where she earned a bachelor's degree in 1892. She took a course in astronomy during her senior year and another after graduation. She returned to Harvard College Observatory as a volunteer research assistant in 1895 and was appointed to the permanent staff in 1902. She was assigned by the director of the Harvard College Observatory to develop photographic measurements that were eventually accepted among the astronomers of the world and became known as the Harvard Revised Magnitude Scale, or Harvard Standard. Leavitt soon became head of the department of photographic stellar photometry at the Observatory, although much of her work was published in reports under the name of the Observatory Director at the time, Edward C. Pickering. Although she never received the recognition as some other female astronomers of her generation, such as **Annie Jump Cannon**, Leavitt certainly deserved it. Her research revealed what are now known to be satellite galaxies of the Milky Way, and her methods helped later astronomers to determine the distances from the Earth of similar stars within our own galaxy and in distant galaxies. Interestingly, in a discipline that relied so heavily on sight and analysis of detailed imagery, both Cannon and Leavitt were partially deaf.

Leavitt was a member of the American Association of University Women, the American Association for the Advancement of Science, and the American Astronomical and Astrophysical Society. She was elected an honorary member of the American Association of Variable Star Observers. Both an asteroid and a moon crater are named after her.

Further Resources

Byers, Nina and Gary A. Williams. 2006. *Out of the Shadows: Contributions of Twentieth-Century Women to Physics*. New York: Cambridge University Press.

Johnson, George. 2005. *Miss Leavitt's Stars: The Untold Story of the Woman Who Discovered How to Measure the Universe*. New York: W.W. Norton.

Ledley, Tamara (Shapiro)

b. 1954

Climatologist

Education: B.S., University of Maryland, 1976; Ph.D., meteorology, Massachusetts Institute of Technology, 1983

Professional Experience: research associate, Space Physics and Astronomy and Earth Systems and The Energy and Environment Systems Institute, Rice University, 1983–1985, assistant research scientist, 1985–1990, senior faculty fellow, 1990–1998; senior scientist, TERC, Cambridge, Massachusetts, 1997–, interim director, Center for Science Teaching and Learning, 2009–

Concurrent Positions: consultant, Houston Museum of Natural Science, 1989–1990; director, teacher training program, George Observatory, Rice University, 1990–1992; visiting lecturer, geology and geophysics, Rice University, 1993; assistant director, Summer Solar Institute, Rice–Houston Museum of Natural Science, 1993; associate editor, *Journal of Geophysical Research—Atmosphere*, 1993; associate research scientist, Texas A&M University, 1995–1996; lecturer, mathematics and sciences, Babson College, Massachusetts, spring 1997; visiting scientist, Department of Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology, 1997–1998; adjunct professor, University of Massachusetts, Dartmouth, 2008–2009

Tamara Ledley is known for her research on the role of the polar regions in shaping climate and has examined how the interaction of atmosphere and sea with ice and oceans influences climate change. She has conducted research in both Alaska and Antarctica, and been active in presenting information on climatology to elementary school children as well as to university students. There is sometimes confusion about the difference between meteorology and climatology. Meteorology is the science dealing with the atmosphere and its phenomena, including weather, while climatology is the science that deals with the phenomenon of climate or climatic conditions. Ledley has consulted on numerous private and government projects related to climate change. She was a member of the working team at the Alaska facility for the National Aeronautics and Space Administration (NASA) (1988) and a member of the McMurdo Sound working team (1990). She also was a participant in the workshop on the Arctic initiative of the Office of Naval Research (1988), a participant in the U.S. Global Change Research program's climate modeling forum (1988), and a member of the committee on global and environmental change of the American Geophysical Union (1993).

In addition to several academic affiliations, Ledley has participated in many outreach programs bringing science to the public and the schools through science curriculum building and teacher training programs on climatology, and is a senior scientist at TERC, Inc., a producer of science and math education curriculum and programs. She has received grants from the National Science Foundation to fund various classroom and teacher professional development materials, including the Earth Exploration Toolbook and the Digital Library for Earth System Education.

Ledley is a member of the American Association for the Advancement of Science, American Meteor Society, and Ocean Society.

Further Resources

TERC. "Tamara Shapiro Ledley." Earth Exploration Toolbook, TERC, Carleton College. <http://serc.carleton.edu/eet/people/ledley.html>.

Leeman, Susan (Epstein)

b. 1930

Endocrinologist, Physiologist

Education: B.A., Goucher College, 1951; M.A., Radcliffe College, 1954, Ph.D., physiology, 1958

Professional Experience: instructor, physiology, Harvard Medical School, 1958–1959; fellow, neurochemistry, Brandeis University, 1959–1962, senior research associate, biochemistry, 1962–1966, adjunct assistant professor, 1966–1968, assistant research professor, 1968–1971; assistant to associate professor, physiology, Laboratory of Human Reproduction and Reproductive Biology, Harvard Medical School, 1972–1980; professor, physiology, Medical School, University of Massachusetts, 1980–1992, director, Interdepartmental Neuroscience Program, 1984–1992; professor, pharmacology, Boston University Medical School, 1992–

Susan Leeman is considered one of the founders of the field of neuroendocrinology based on her research on peptides. She is renowned for her work with substance P and neurotensin, peptides that help govern the functioning of the nervous, endocrine,



Endocrinologist and physiologist, Susan Leeman. (Courtesy of BU Photo Services)

and immune systems. Neuroendocrinology is the study of the anatomical and physiological interactions between the nervous and endocrine systems. During the 1960s, she made a chance finding of a chemical that turned out to be substance P, a transmitter that is distributed throughout both the central and the peripheral nervous systems and the spinal cord, which had been discovered in the 1930s but had never been isolated. She and her colleagues isolated and characterized the peptide as well as discovering another one, neurotensin, which is involved in the relaxation and contraction of the blood vessels and may be involved in psychiatric disorders and, perhaps, regulation of the menstrual cycle. While in graduate school, Leeman began her work on corticotropin, a hormone used in the treatment of rheumatoid arthritis and rheumatic fever. It was while she was trying to purify corticotropin that she made the chance finding of substance P.

Leeman was elected to membership in the National Academy of Sciences in 1991 and received the Academy's Fred Conrad Koch Award in 1994. She has received numerous other awards, including the Excellence in Science Award of Eli Lilly and Company (1993). She is a member of the Endocrine Society, Society for Neuroscience, American Association for the Advancement of Science, and American Physiological Society.

Further Resources

Boston University Medical School. Faculty website. <http://www.bumc.bu.edu/Dept/Content.aspx?DepartmentID=65&PageID=7764>.

LeMone, Margaret Anne

Meteorologist

Education: A.B., mathematics, University of Missouri, 1967; Ph.D., atmospheric sciences, University of Washington, 1972

Professional Experience: postdoctoral fellow, Advanced Study Program, National Center for Atmospheric Research (NCAR), 1972–1973, acting project leader, GATE Group, 1974–1975, Ph.D. scientist, 1973–1978, staff scientist, Mesoscale Research Section, 1978–1980, staff scientist, GATE Group, Cloud Systems Division, 1980–1982, scientist, 1982–1992, senior scientist, 1992–

Concurrent Positions: affiliate professor, Colorado State University, 1984–1990; adjunct professor, University of Colorado, 1994–; affiliate professor, Colorado State University, 1996–; Advanced Study Program and National Oceanic and Atmospheric

Administration (NOAA) Aeronomy Lab, 1998–1999; Chief Scientist, Global Learning and Observations to Benefit the Environment (GLOBE), 2003–

Margaret “Peggy” LeMone is a meteorologist whose research focuses on storm and cloud systems. She is considered an observational meteorologist because she focuses on the lower area of the Earth’s atmosphere known as the *planetary boundary layer*. She combines aircraft and radar observations with mathematical models to understand the relationship between atmospheric weather systems and the Earth’s surface in terms of vegetation, soil properties, and terrain. She has conducted weather-watching fieldwork around the world, including in West Africa, Australia, the Solomon Islands, Mexico, and Taiwan. She has been affiliated with NCAR in a variety of staff scientist and researcher positions since 1972, and has been senior scientist there since 1992. Since 2003, she has served as Chief Scientist of GLOBE, an international earth sciences educational program supported in part by the National Science Foundation and National Aeronautics and Space Administration (NASA).

LeMone has written numerous scientific articles, pamphlets, encyclopedia entries, and weather portions of elementary and high school textbooks. She has served and consulted on numerous government research boards, including National Research Council Committees on Road Weather, on Tools for Tracking Chemical/Biological/Nuclear Releases in the Atmosphere, on Improving the Effectiveness of U.S. Climate Modeling, and on Atmospheric Sciences and Climate. She has also consulted for the U.S. Department of Energy, National Science Foundation, and NOAA. LeMone has also been committed to science education from elementary through high school and college, and has been an invited speaker and mentor for organizations promoting women and minorities in the sciences, including as founding chair (1975–1978) of the American Meteorological Society (AMS) Board on Women and Minorities. She has also written several articles on women scientists working in meteorology.

LeMone was elected to the National Academy of Engineering in 1997. She is a fellow of the American Association for the Advancement of Science, American Geophysical Union, and American Meteorological Society (president, 2010). She is the recipient of an Editor’s Award of the *AMS Journal of Atmospheric Sciences* (1989), the NCAR Education Award (1995), and the AMS Charles Anderson Award (2004).

Further Resources

National Corporation for Atmospheric Research. “Margaret (Peggy) LeMone.” <http://box.mmm.ucar.edu/individual/lemone/>.

Leopold, Estella Bergere

b. 1927

Paleoecologist

Education: B.A., University of Wisconsin, 1948; M.S., University of California, Berkeley, 1950; Ph.D., botany, Yale University, 1955

Professional Experience: assistant research hydrologist, Laboratory of Tree Ring Research, University of Arizona, 1951; mycologist, Forest Products Laboratory, Madison, Wisconsin, 1952; research assistant, Genetics Experiment Station Research, Smith College, 1952; teaching assistant, plant science and zoology, Yale University, 1952–1954; research botanist, Paleontology and Stratigraphy Branch, U.S. Geological Survey, Denver, Colorado, 1955–1976; director, Quaternary Research Center, University of Washington, Seattle, 1976–1982; professor, Department of Botany and College of Forest Resources, University of Washington, Seattle, 1982–1999, emeritus

Concurrent Positions: adjunct professor, biology, University of Colorado, 1967–1976; visiting professor, Department of Botany and Institute for Environmental Studies, University of Wisconsin, Madison, 1971–1972; member and chair, Aldo Leopold Foundation, 1996–2004 (president 1996–1998 and 2004)



Paleoecologist, Estella Leopold.
(Courtesy of University of Washington/
UnivPhoto)

Estella Leopold is one of the leading authorities on paleoecology, which is the study of prehistoric organisms and their environments. She describes her work as comparing the pollen and spores that exist today with those found in rocks for a particular earlier time period. In this way, researchers try to determine the landscape and climate represented by fossils, which are probably the most important evidence of environments of the past. In her research in the Rocky Mountains, she found that extinction and evolution are highest in the middle of the continent because of the variable seasonal changes, while the coastal areas, which have more moderate climates, are able to sustain older species, such as the giant redwood. She was one of

the leaders in the successful campaign to save Colorado's Florissant fossil beds, and in 1962, the National Park Service decided to designate the fossil beds as a national monument, but did not enact legislation. Meanwhile, developers started building recreational subdivisions in the park. In 1969, the Defenders of Florissant, Inc. persuaded the U.S. Congress to enact legislation to designate 6,000 acres for the national monument. She was a past director of the Quaternary Research Center at the University of Washington, Seattle (the Quaternary period, the present period of the Earth's history, originated about 2 million years ago).

Leopold developed her interest in ecology in her childhood under the tutelage of her father, the conservationist and writer Aldo Leopold. Estella received an undergraduate degree in botany from the University of Wisconsin, Madison, where her father taught wildlife management. Growing up, the family regularly spent weekends on a farm, where they planted tree seedlings and restored an old cornfield back to a tall-grass prairie. All five Leopold children followed careers in science, and Estella and her two brothers, Starker and Luna, are all members of the National Academy of Sciences.

Leopold was elected to membership in the National Academy of Sciences in 1974. She has served on many distinguished scientific committees on conservation and ecology, and is a fellow of the American Association for the Advancement of Science (president, 1995) and of the Geological Society of America. She is a member of the American Quaternary Association (president, 1982–1984), Botanical Society of America, Ecological Society of America, and American Academy of Arts and Sciences. She is also on the board and past president of the Aldo Leopold Foundation, which works for ecological and environmental awareness and protection in her father's name.

Further Resources

University of Washington, Seattle. "Pollen and Seed Laboratory." <http://protist.biology.washington.edu/eleopold/>.

The Aldo Leopold Foundation. <http://www.aldoleopold.org>.

Lesh-Laurie, Georgia Elizabeth

b. 1938

Developmental Biology

Education: B.S., Marietta College, 1960; M.S., University of Wisconsin, 1961; Ph.D., biology, Case Western Reserve University, 1966

Professional Experience: instructor, biology, Case Western Reserve University, 1965–1966; assistant professor, biological science, State University of New York, Albany, 1966–1968; assistant professor, Case Western Reserve University, 1969–1973, associate professor, 1974–1977, assistant dean, 1973–1976; professor, biology, Cleveland State University, 1977–1990, dean, College of Graduate Studies, 1981–1986, dean, College of Arts and Sciences, 1986–1990, interim provost, 1989–1990; vice chancellor of academic affairs, University of Colorado, Denver, 1990–1995, interim chancellor, 1995–1997, chancellor, 1997–2003

Georgia Lesh-Laurie is renowned for her research on a drug that can be used in place of digitalis for the treatment of congestive heart failure. Digitalis, made from the purple foxglove plant, increases the heart's pumping power without increasing oxygen demand, but patients with kidney problems are unable to use it. Lesh-Laurie's stimulant is a protein found in the toxin of the hydra, a small freshwater cousin of the jellyfish, and the protein was discovered after people stung by jellyfish noticed a sudden neurological and cardiovascular response. Sponsored by the American Heart Association, she continued work in the 1980s on developing a drug incorporating the protein.

Early in her career, Lesh-Laurie assumed administrative responsibilities in addition to her teaching and research. She served as assistant dean for three years at Case Western Reserve, and at Cleveland State University, she was department chair, dean of the College of Graduate Studies, dean of the College of Arts and Sciences, and interim provost for a year. She moved to the University of Colorado as vice chancellor of academic affairs in 1990 and then served as chancellor of that institution for seven years before retiring in 2003. Lesh-Laurie has been a member of the American Association for the Advancement of Science, American Society of Zoologists, Society for Developmental Biology, New York Academy of Sciences, and American Society for Cell Biology.

L'Esperance, Elise Depew Strang

1878 1959

Pathologist

Education: M.D., Woman's Medical College of New York, 1900

Professional Experience: intern, New York Babies Hospital, 1900; physician, private practice, 1901–1908; physician and instructor, Cornell University Medical Center, 1910–1920, assistant professor, 1920–1932; director, Kate Depew Strang

Tumor Clinic, New York Infirmary, 1933–1941; associate professor to professor, Cornell University Medical Center, 1942–1950

Concurrent Positions: editor, *Medical Woman's Journal*, 1936–1941; editor, *Journal of the American Medical Women's Association*, 1946–1948

Elise L'Esperance was a physician who established family clinics and promoted the early detection and treatment of cancer. Her research focused on the pathology and treatment of malignant tumors. Because their mother died from cancer, L'Esperance and her sister, May Strang, used an inheritance to open the first of three clinics in New York City devoted to the detection of cancer in 1933. The clinic offered complete physical examinations to apparently healthy women and provided referral service for any sign of cancer. Several new techniques were developed at the Strang clinics, such as the Pap smear for the diagnosis of cervical cancer. She staffed the clinic entirely with women physicians, and she conducted an extensive campaign of public education. Later, she opened other clinics where the services were expanded to men and children. Other groups in other cities built upon this model; the value of early detection became more widely accepted both by the public and the medical profession. She also worked in the fields of tuberculosis and Hodgkin's disease.

L'Esperance was a member of the last class to graduate from the Women's Medical College of New York in 1899, but, due to an attack of diphtheria, did not receive her degree until the next year. After serving her internship, she engaged in private practice in New York and Detroit. She became increasingly interested in pathology, and she accepted a position at Cornell's medical college. She left Cornell to direct the Kate Depew Strang Tumor Clinic in New York for eight years, but returned to teaching, eventually advancing to full professor right before she retired in 1950.

In addition to focusing her efforts on women's health, and serving as editor of two women's health journals, L'Esperance actively promoted careers in medicine for women. She received numerous awards, the most prestigious of which was the Albert Lasker Award of the American Public Health Association (1951). She also received the Elizabeth Blackwell Citation in 1950 for her achievements in pathology and cancer detection. She was elected a fellow of the New York Academy of Medicine, and she was named an honorary member of the American Radiologists Society. She was president of the American Medical Women's Association in 1948. Her other memberships included the American Medical Association, the American Association of Pathologists and Bacteriologists, the American Association of Immunologists, the American Radium Society, the Harvey Society, and the American Cancer Society.

Levelt-Sengers, Johanna Maria Henrica

b. 1929

Physicist

Education: B.Sc., physics and chemistry, University of Amsterdam, 1950, M.S., 1954, Ph.D., physics, 1958

Professional Experience: research associate, Van der Waals Laboratory, University of Amsterdam, 1958–1959; research physicist, 1959–1963; physicist, Heat Division, U.S. National Bureau of Standards, 1963–1984, physicist and senior fellow, National Bureau of Standards/National Institute of Standards and Technology, 1984–1995, emeritus

Concurrent Positions: research associate and instructor, theoretical chemistry, University of Wisconsin, 1958–1959; lecturer, University of Nijmegen, Netherlands, 1962–1963; visiting professor, University of Louvain, Belgium, 1971; visiting research scientist, Instituut voor Theoretische Fysica, Amsterdam, 1974–1975

Johanna Levelt-Sengers is renowned for her research on critical phenomena and fluid mixtures. Her research included thermodynamic properties of fluids and fluid mixtures; critical phenomena in fluids; equation of state, theoretical and experimental; and supercritical aqueous systems. She has been involved in establishing indexes or standards on water and steam properties and power for the International Association for the Properties of Water and Steam (IAPWS) and the American Society of Mechanical Engineers (ASME) Steam Tables. Her husband, Jan V. Sengers, is also a physicist, and the two came to the United States in 1963 to work for the National Bureau of Standards. The Sengers have collaborated and published numerous papers together, and in 1992, the couple were awarded honorary doctorates from the Technical University of Delft in their home country of The Netherlands. In 1995, she retired from a more than 30-year career at the National Institute of Standards and Technology (formerly National Bureau of Standards), but has remained active as a conference organizer, committee member on the ASME International Steam Tables, and author of a book on thermodynamics, *How Fluids Unmix*, published in 2002. She has also co-chaired the InterAcademy Council's advisory panel on promoting women in science and technology careers.

Levelt-Sengers is one of the few women scientists who has been elected a member of both the National Academy of Engineering (1992) and the National Academy of Sciences (1996). She has received numerous other awards, such as the Edward Uhler Condon Award (1975), Special Achievement Award (1977), and Certificate of Recognition (1978), all from the National Bureau of Standards;

the Department of Commerce Silver Medal (1972) and Gold Medal (1978) awards; the Interagency Committee for Women in Science and Engineering's WISE Award (1985); the Alexander von Humboldt Award (1991); the L'Oréal-UNESCO Women in Science Award (2003); and ASME's Yeram S. Touloukian Award (2006). She is a fellow of the American Physical Society and a member of the American Society of Mechanical Engineers, American Institute of Chemical Engineers, American Chemical Society, and International Association for the Properties of Water and Steam (president, 1991–1991; U.S. national representative, 1990–2004). She is also a member of the Royal Netherlands Academy of Arts and Sciences and the Royal Holland Society of Sciences and Humanities.

Further Resources

National Institute of Standards and Technology. "Johanna M. H. Anneke Levelt Sengers (Scientist Emeritus)." <http://www.boulder.nist.gov/div838/ProfilesSengers.html>.

Leverton, Ruth Mandeville

1908 1982

Nutritionist

Education: B.S., home economics, University of Nebraska, 1928; M.S., nutrition, University of Arizona, 1932; Ph.D., nutrition, University of Chicago, 1937

Professional Experience: high school teacher, 1928–1930; teaching fellow, home economics, University of Arizona, 1930–1932, assistant, experiment station, 1932–1934; assistant professor, home economics, University of Nebraska, 1937–1940; associate specialist, Bureau of Home Economics, U.S. Department of Agriculture (USDA), 1940–1941; associate professor, home economics and director, human nutrition research, University of Nebraska, 1941–1949, professor, 1949–1953; professor, home economics and assistant director, agricultural experiment station, Oklahoma Agricultural and Mechanical College, 1954–1957; assistant director, human nutrition research division, USDA, 1957–1958, associate director, institute of home economics, 1958–1961, assistant director of administration, 1961–1971, science advisor, 1971–1974

Concurrent Positions: Fulbright professor, University of the Philippines, 1949–1950

Ruth Leverton was a nutritionist whose research included human metabolism and requirements of minerals, nutritive value of food products, and blood

regeneration and prevention of anemia. Her research had an important impact on American food practices at mid-century, including decisions about wartime food rationing and nutrition, the development of a system of Recommended Dietary Allowances, the fortification of grains, and food assistance programs. Following a pattern of many educated women of her generation, she taught school for several years after she received her undergraduate degree. But Leverton decided to continue her own education, earning a master's degree in nutrition at the University of Arizona before moving to the University of Nebraska for a doctorate. Her research focused on women's iron needs and made connections between insufficient protein intake and iron-deficiency anemia. Leverton's research was among the first to highlight the differences between men's and women's dietary and nutritional needs.

Leverton worked briefly for the U.S. Department of Agriculture at the beginning of World War II, but returned to academia at Nebraska where she rose from associate professor to professor of home economics between 1941 and 1953. She accepted a position at Oklahoma Agricultural and Mechanical College (now Oklahoma State University) as professor of home economics and assistant director of the agricultural experiment station. She returned to the USDA in 1957 as assistant director of Human Nutrition Research, the highest-ranking woman at the USDA at that time. She remained at the USDA in various positions until her retirement in 1974. Throughout this time, she also traveled extensively throughout Asia, Africa, Latin America, and Europe. She represented the United States on the International Rice Commission and the International Congress of Nutrition, and lectured on nutritional health at conferences worldwide.

Leverton published more than 200 academic papers, was the author of the classic book *Food Becomes You* (1952), and was the co-author of *Your Diabetes and How To Live with It* (1953). Leverton received the Borden Award for Dairy Foods Research (1942 and 1953), the Distinguished Service Award from the USDA (1972), the Conrad A. Elvehjem Award of the American Institute of Nutrition (1973), the Federal Woman's Award (1977), and a Medallion Award of the American Dietetic Association (1977). She was the first woman to receive an honorary doctorate of science from her alma mater, University of Nebraska, in 1961. She was a member of the American Dietetic Association, the American Home Economics Association, the American Public Health Association, the American Institute of Nutrition, and the American Association for the Advancement of Science.

Further Resources

Hampl, Jeffrey S. and Marylynn I. Schnepf. "Ruth M. Leverton (1908–1982)." <http://jn.nutrition.org/cgi/content/full/129/10/1769>.

Leveson, Nancy G.

Aerospace Engineer, Computer Scientist

Education: B.A., mathematics, University of California, Los Angeles, 1965, M.S., Graduate School of Management, 1967, Ph.D., computer science, 1980

Professional Experience: systems engineer, IBM, 1967–1970; assistant professor, information and computer science, University of California, Irvine, 1980–1985, associate professor, 1985–1990, professor, 1990–1993; Boeing Professor of Computer Science and Engineering, University of Washington, Seattle, 1993–1998; professor, aeronautics and astronautics, and professor, engineering systems, Massachusetts Institute of Technology (MIT), 1998–

Concurrent Positions: visiting professor, Laboratory for Computer Science, MIT, 1988–1989; adjunct professor, computer science, University of British Columbia, 1993–; Hunsaker Visiting Professor, aeronautics and astronautics, MIT, 1997–1998

Nancy Leveson is an aerospace engineer who pioneered a new research field in software safety systems, which involves using computer programs to prevent and analyze safety situations where property or life are at risk. Her research has focused particularly in the area of air and space flight, and involves creating accident models that take into account the role of computers as well as human decision-making in risk management. She has published over 200 scientific papers and articles, and her system for aircraft collision avoidance has been adopted by the Federal Aviation Administration (FAA) for use in commercial airlines. She has been a distinguished invited guest lecturer at national and international universities and a consultant or advisory council member for numerous industry and government organizations related to software-related safety issues in nuclear power plants, transportation, air traffic control, and aerospace systems and accidents, including authoring an analysis of the *Columbia* space shuttle explosion of 2003. Leveson completed her undergraduate and graduate education at the University of California, Los Angeles, including a doctorate in computer science in 1980. She taught at the University of California, Irvine and at the University of Washington, Seattle before joining the faculty at MIT, where she holds joint appointments in the departments of Aeronautics and Astronautics, and in Engineering Systems.

Leveson was elected to the National Academy of Engineering in 2000. She is a fellow of the Association for Computing Machinery (ACM) and the International Association for the Advancement of Space Safety (IAASS), and has been on the Board of Directors of the Computing Research Association (CRA), International Council on System Engineering, and Geisinger Institute on Electronic Health

Records Safety. She was the recipient of the AIAA Information Systems Award (1995), ACM Allen Newell Award (1999), CRA Habermann Award (2004), ACM SIGSOFT Outstanding Software Engineering Research Award (2004), and System Safety Society Professional Achievement Award.

Further Resources

Massachusetts Institute of Technology. Faculty website. <http://sunnyday.mit.edu/>.

Levi-Montalcini, Rita

b. 1909

Neuroembryologist

Education: M.D., University of Turin, 1936, 1940

Professional Experience: research associate, zoology, Washington University, St. Louis, 1947–1951, associate professor, 1951–1958, professor, 1958–1981

Concurrent Positions: director, Research Center of Neurobiology of the Consiglio Nazionale delle Ricerche (CNR), Rome, 1961–1969, Laboratory of Cellular Biology, 1969–1978

Rita Levi-Montalcini is a neurologist who shared the Nobel Prize in Physiology or Medicine in 1986 with colleague Stanley Cohen for their discovery of the nerve growth factor (NGF), responsible for the rapid growth of immature cells implicated in diseases such as cancer and Alzheimer's. Born and educated in Italy, she conducted the early stages of her prize-winning research beginning in 1952 while on the faculty at Washington University in St. Louis, Missouri. Her research was focused on the effect of a nerve growth factor isolated from the mouse salivary gland on the sympathetic nervous system and of an antiserum to the nerve growth factor. In order to advance the work more quickly, she smuggled two tumor-infected mice on the plane to Rio de Janeiro to consult with a colleague about the process of growing tissues *in vitro*. She spent the next six years on the project until she achieved success. With a National Science Foundation grant in 1961, she set up a small research unit in Rome so she could be close to her family. After a few years, when she received grants from the Italian government to establish an independent research institute, she alternated six months in Rome and six months in the United States.

As teenagers in Italy, she and her twin sister Paola were sent to a finishing school until, at age 20, she finally convinced her father that she would never marry,

so he hired tutors in mathematics, science, Latin, and Greek to prepare her for university entrance examinations. After completing her medical degree, she continued research at the University of Turin. There she learned a new technique of staining embryonic chick neurons with chrome silver to make nerve cells stand out in the smallest detail. She continued using this technique in her private research when she was dismissed from her position at the University of Turin because her family was Jewish. She was unable to practice medicine, use the university library, or even visit friends at the university. During World War II, she set up a laboratory in her home and hid her experiments from the authorities. Since she was unable to publish her papers in Italian journals, she received international attention when they were published in Swiss and Belgian journals that could be read in the United States. After the war, she returned to the laboratory at the University of Turin until she was invited to join a research group in 1947 at Washington University after the director read the papers she had published. She spent 30 years in St. Louis, returning to Italy permanently upon her retirement in 1981. In 2009, Levi-Montalcini celebrated her hundredth birthday.

Levi-Montalcini was elected to the National Academy of Sciences in 1968, and in 1987, she was awarded the National Medal of Science, the highest scientific honor in the United States. With her collaborator, Stanley Cohen, she also jointly received the Louisa Gross Horwitz Prize from Columbia University (1983) and the Albert Lasker Award for Basic Medical Research (1986). In 2001, she was named an honorary Senator for Life in the Italian Senate. She has received honorary degrees from Polytechnic University of Turin (2006) and Complutense University of Madrid, Spain (2008). She has been a member of the American Association for the Advancement of Science, Society for Developmental Biology, American Association of Anatomists, and Pontifical Academy of Sciences. In 1988, she published an autobiography, *In Praise of Imperfection: My Life and Work*.



Rita Levi-Montalcini shared the 1986 Nobel Prize for Physiology or Medicine with Stanley Cohen for her discovery of nerve growth factor, the protein that promotes cell growth in the peripheral nervous system. (Nobel Foundation)

Further Resources

McGrayne, Sharon Bertsch. 1993. *Nobel Prize Women in Science: Their Lives, Struggles, and Momentous Discoveries*. Secaucus, NJ: Birch Lane Press.

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

Lewis, Margaret Adaline Reed

1881–1970

Embryologist

Education: Woods Hole Marine Biological Laboratory, 1900; A.B., Goucher College, 1901; Bryn Mawr College, 1902–1903, 1908–1909; Columbia University, 1903–1906; University of Zurich, 1906; University of Paris and University of Berlin, 1908

Professional Experience: assistant, zoology, Bryn Mawr College, 1901–1902; lecturer, physiology, New York Medical College for Women, 1904–1907; lecturer, Barnard College, 1907–1909; instructor, anatomy and physiology, training school for nurses, Johns Hopkins Hospital, 1911–1912; collaborator, department of embryology, Carnegie Institution, 1915–1927, research associate, 1927–1940; member, Wistar Institute, 1940–1958, emeritus member, 1958–1964

Concurrent Positions: preparator in zoology, Columbia University, 1903–1906; lecturer, New York Medical College, 1904–1905

Margaret Lewis was a world-renowned authority on tumors, with expertise in the chemotherapy of cancer, the cytology of living cells in tissue cultures, the origin of epithelioid cells, and the relation of white blood cells to tumors. While working in Berlin, she may have conducted the first known successful *in vitro* mammalian tissue culture experiment. She and her husband, Warren H. Lewis, perfected the technique to develop clear solutions on special slides. This technique is known as the Lewis culture, and the medium is called the Locke-Lewis solution. In later years, they studied the chemotherapy of dyes in cancer. As early as 1915, they were able to provide a reasonably complete description of a number of living cells microscopically. By 1917, they had begun to determine some physiological activities. Later, at the Carnegie Institution, she added important studies of the effects of acidity on these processes. She published nearly 150 scientific papers, often co-authored with her husband.

Lewis received her undergraduate degree from Goucher College in 1901 and studied at a number of universities in the United States and Europe without completing a graduate degree. She held brief appointments at several U.S. colleges

before joining the Carnegie Institution department of embryology. In 1940, she was elected a member of the Wistar Institute, where she held emeritus status for several years after her retirement. She and her husband jointly received the Gerhard Gold Medal of the Pathological Society of Philadelphia and an honorary degree from Goucher College in 1938. She was an honorary life member of the Tissue Culture Society and a member of the American Association of Anatomists. She is identified in some sources as “Margaret Reed” or as “Mrs. Warren H. Lewis.”

Libby, Leona Woods Marshall

1919 1986

Physicist

Education: B.S., University of Chicago, 1938, Ph.D., chemistry, 1943

Professional Experience: research associate, metallurgical laboratory, Manhattan Project, 1942–1944; physicist, Hanford Engineering Works, Washington, 1944–1946; fellow, Institute for Nuclear Studies, University of Chicago, 1946–1947, research associate, 1947–1953, assistant professor, physics, 1953–1960; associate professor, physics, New York University, 1960–1962, professor, 1962–1963; associate professor, University of Colorado, Boulder, 1963; staff member, Rand Corporation, California, 1963–1970; staff member, R&D Associates, California, 1970–1976

Concurrent Positions: consulting physicist, E. I. du Pont de Nemours & Company, 1944–1946; fellow, Institute for Advanced Studies, Princeton, New Jersey, 1957–1958; visiting scientist, Brookhaven National Laboratory, 1958–1960; visiting scientist, Brookhaven National Laboratory, 1958–1986; visiting adjunct professor, University of California, Los Angeles, 1973–1986

Leona Marshall Libby was a physicist whose research focused on high-energy nuclear physics, nuclear reactions, fundamental particles, astrophysics, and stable isotopes in tree thermometers. She discovered that historical climate could be measured from the isotope ratios in tree rings. She also conducted early research on neutron and proton scattering. She was a member of the Manhattan Project, the group that built the first and second Argonne reactors, the Oak Ridge reactor, and the three Hanford reactors. She worked with the most important scientists in this field in the mid-twentieth century, including several Nobel Laureates. For her doctorate, she studied with Robert Mulliken, who won the Nobel Prize in Chemistry in 1966; even before completing her Ph.D., she became the first female researcher at the Chicago Metallurgical Laboratory working with Enrico Fermi, who had won the Nobel Prize in Physics in 1938. Their top-secret work on the first



Nuclear physicist Leona Woods Marshall Libby worked on the Manhattan Project during World War II. (AP/Wide World Photos)

nuclear fission reactor and development of the atomic bomb became later known as the Manhattan Project. Many women scientists were able to secure government contracts and positions during World War II, and numerous women physicists and chemists were ultimately involved in the Manhattan Project. Libby (in this early period known professionally by her first married name, Marshall) spent several years as a researcher and then assistant professor with the Institute for Nuclear Studies at the University of Chicago, where she studied nuclear explosions and neutron diffusion.

In 1958, Leona Marshall moved to the Brookhaven National Laboratory in New York and later taught atomic and nuclear physics at New York University. She left New York in 1964 to teach physics at the University of Colorado, Boulder, and in 1966 married her second husband, Willard Frank Libby, another prominent chemist who had recently received the Nobel Prize in 1960 for his work on radio-carbon dating. In 1972, the couple relocated to California, where Leona worked first as a visiting professor and then adjunct instructor at University of California, Los Angeles. There she continued her research in particle physics and began her work on environmental engineer-

ing, tree rings and ancient climates, publishing two books in the 1970s on environmental issues. After Willard Libby's death in 1980, Leona Marshall Libby collected and edited his papers and published *The Life Work of Nobel Laureate Willard Frank Libby* in 1982.

In the 1970s and 1980s, Leona Marshall Libby remained an outspoken advocate for nuclear power in the face of increasing public criticism. In 1979, she published an autobiography of her early work in nuclear physics entitled *The Uranium People*. She was elected a fellow of the American Physical Society and the Royal Geographical Society, and was a member of the National Science Foundation Postdoctoral Fellowship Evaluation Board.

Further Resources

Howes, Ruth and Carolyn L. Herzenberg. 1999. *Their Day in the Sun: Women of the Manhattan Project*. Philadelphia, PA: Temple University Press.

Linares, Olga Frances

b. 1936

Anthropologist

Education: B.A., anthropology, Vassar College, 1958; Ph.D., anthropology, Harvard University, 1964

Professional Experience: instructor, anthropology, Harvard University, 1965; lecturer, anthropology, University of Pennsylvania, 1966–1971; research scientist to senior scientist, Smithsonian Tropical Research Institute, 1973–2008, emerita

Concurrent Positions: research curator, Center for American Archaeology, Peabody Museum, Harvard University, 1974–

Olga Linares is an anthropologist recognized for her research on the rural populations of western Africa and Central America. Her research centers on the agrarian practices and political economy of western African and Central American rural populations, and on human adaptations to the tropical forest, past and present. She is working in the area of economic anthropology among primarily agrarian populations and looks not only at the types of crops that are grown and marketed but also at the sexual division of labor. She examines the social, spatial, and temporal relations in archaeological perspective.

The strength of her research can be seen in the book *Power, Prayer, and Production: The Jola of Casamance, Senegal* (1992). The central thesis is that ideology and production are part of the same system and any consideration of the division of labor—whether by gender, age, status, or ethnic identity—must take into account the influence of ideology. She compares three communities that are engaged in intensive wet-rice cultivation but structure their agriculture very differently. One is a non-Muslim community in which both men and women commune with spirit shrines, and

relations between the generations and the sexes tend to be reciprocal and cooperative. Another community has adopted Islam and has divided production along territorial, generational, gender, and kinship lines. The third community also is Islamic and there is a strong Islamic community nearby; this group has more extreme inequality and social separation between the sexes and the generations. In each case, Linares examined the same set of factors: marriage and residence patterns, cropping and land tenure arrangements, the role of ritual and religious powers and duties, the organization of labor, the effects of introduced technologies, and the dynamics of social power and conflict. After an appointment as a lecturer in anthropology at the University of Pennsylvania, Linares secured joint appointments with the Smithsonian Tropical Research Institute, first as a research scientist and then as a senior scientist, and with the Center for American Archaeology at the Peabody Museum of Harvard University as a research curator. She has written numerous journal articles and book chapters.

Linares was elected to membership in the National Academy of Sciences in 1992. She is a fellow of the American Association for the Advancement of Science and a member of the American Anthropological Association, African Studies Association, Royal Anthropological Association, and Latin American Studies Association.

Further Resources

Smithsonian Tropical Research Institute. "Olga F. Linares." http://www.stri.org/english/scientific_staff/staff_scientist/scientist.php?id=24.

Lippincott, Sarah Lee

b. 1920

Astronomer

Education: student, Swarthmore College, 1938–1939; B.A., University of Pennsylvania, 1942; M.A., astronomy, Swarthmore College, 1950

Professional Experience: research assistant, astronomy, Swarthmore College, 1942–1951, research associate, 1952–1972, lecturer, 1961–1976, director, Sproul Observatory, 1972–1981, professor, 1977–1981, emerita

Concurrent Positions: visiting astronomer, Lick Observatory, University of California, Santa Cruz, 1949; visiting astronomer, California Institute of Technology, 1978

Sarah Lippincott is known for her research in astrometry, which is the branch of astronomy that deals with the measurement of the positions and motions of celestial bodies. One of her projects was to look for extrasolar planets or planetlike

companions to nearby stars. The Sproul Observatory at Swarthmore College has had a long-term program of tracing the motions of stars within five parsecs of the Earth to look for such perturbations. The data, going back an average of 50 years, are on photographic plates containing images of those stars; these are in the archives of the observatory. Lippincott found three stars that were candidates for having unseen companions. In addition to her work at Swarthmore, she was a visiting astronomer at major West Coast observatories. She held a Fulbright fellowship in France and was a member of the French solar eclipse expedition to Oland, Sweden, in 1954. Lippincott spent her entire professional career at Swarthmore College, beginning as a research assistant and eventually becoming professor and director of the Sproul Observatory. She trained many female astronomers at Swarthmore, including well-known cosmologist **Sandra Faber**.

Lippincott held a master's degree, but received an honorary doctorate from Villanova University in 1973. She published numerous papers in scientific journals and is co-author of the book *Point to the Stars*, of which three editions were published between 1963 and 1976. She is a member of the American Astronomical Society and International Astronomical Union (president, 1973–1976). In some sources she is identified by her married name, Zimmerman.

Liskov, Barbara Huberman

b. 1939

Computer Scientist

Education: B.A., mathematics, University of California, Berkeley, 1961; M.S., computer science, Stanford University, 1965, Ph.D., 1968

Professional Experience: applications programmer, Mitre Corporation, 1961–1962; programmer, language translation project, Harvard University, 1962–1963; graduate research assistant, artificial intelligence, Stanford University, 1963–1968; member of technical staff, computer science research and development, Mitre Corporation, 1968–1972; assistant to associate professor, computer science and electrical engineering, Massachusetts Institute of Technology (MIT), 1972–1980, professor, 1980–, NEC Professor of Software Science and Engineering, 1986–1997, Ford Professor of Engineering, 1997–, associate head, computer science, 2001–

Barbara Liskov is recognized as an expert on computer software, and her research on programming methodology, distributed computing, programming languages, and operating systems has been at the forefront of the field of software and computer operating systems. She has been instrumental in designing software that

has formed the basis of widely used programming languages such as C++ and Java. She worked for Mitre Corporation for several years before joining MIT as a faculty member in 1972. As a member of the Programming Methodology Group of the Computer Science and Artificial Intelligence Laboratory at MIT, her work has focused on distributed systems, object-oriented databases, programming languages, software design and upgrades, and, most recently, systems operations plans due to computer failure or hacking, an important area of research in the Internet age. In addition to her academic duties, she has consulted for major computer companies such as Digital Equipment, Hewlett-Packard, NCR, Prime Computers, Cadence, Intermetrics, BBN Corporation, and Cisco Systems.

Liskov received her Ph.D. from Stanford University in 1968, the first woman to earn a doctorate in a computer science program. She was elected to membership in the National Academy of Engineering (1988) and received an honorary doctorate from the Swiss Federal Institute of Technology (ETH) in Zurich (2005). She is the recipient of an Achievement Award from the Society of Women Engineers (1996), the John von Neumann Medal of the Institute of Electrical and Electronics Engineers (IEEE) (2004), the Association for Computing Machinery (ACM) SIGPLAN Lifetime Achievement Award (2008), and the A. M. Turing Award of the Association for Computing Machinery (2009), one of the highest awards in computer science, for her contribution to “virtually every modern computing-related convenience in people’s daily lives.” In 2002, she was profiled as a top scientist in both *Popular Science* and *Discover* magazines. She is a member of the IEEE and the ACM, and a fellow of the American Academy of Arts and Sciences.

Further Resources

Massachusetts Institute of Technology. “MIT’s Magnificent Seven: Women Faculty Members Cited as Top Scientists.” <http://web.mit.edu/newsoffice/2002/women.html>.

Massachusetts Institute of Technology. Faculty website. <http://www.pmg.csail.mit.edu/~liskov/>.

Lochman-Balk, Christina

1907–2006

Geologist, Paleontologist

Education: A.B., Smith College, 1929; A.M., geology, 1931; Ph.D., paleontology, Johns Hopkins University, 1933

Professional Experience: assistant geologist, Smith College, 1929–1931; instructor, Mount Holyoke College, 1935–1940, assistant to associate professor, 1940–1947;

lecturer, physical science, University of Chicago, 1947; lecturer, life sciences, New Mexico Institute of Mining and Technology, 1954, professor, geology, 1955–1972

Concurrent Positions: strategic geologist, New Mexico State Bureau of Mines and Mineral Resources, 1955–1957

Christina Lochman-Balk was a prominent geologist whose research area was the Cambrian paleontology and stratigraphy of the western United States, Mexico, and Newfoundland. In particular, she studied Cambrian trilobites and published several important papers and updates on invertebrate paleontology in North America. She held positions at several universities and eventually rose through the ranks to full professor in a predominantly male profession. After receiving her doctorate, she accepted a position at Mount Holyoke in 1935, advancing to assistant professor and associate professor. After her marriage in 1947, she followed her husband Robert Balk to the University of Chicago, where he was appointed a professor of geology; there, she could only get a position as a lecturer. The couple relocated to New Mexico where, again, he was a professor and she a lecturer until she was promoted after his death in 1955. She remained at the New Mexico Institute of Mining and Technology (New Mexico Tech) until her retirement in 1972, also serving a two-year appointment as a strategic geologist for the New Mexico State Bureau of Mines.

During her tenure at the New Mexico Institute of Mining and Technology, she was renowned as a teacher and as a researcher, and helped expand the program's offerings for doctoral studies in the earth sciences. She supervised numerous doctoral students who went on to make important geological discoveries of their own. As Dean of Women, she was particularly interested in promoting the careers of female scientists. She also established two fellowship opportunities for student research in geology and earth sciences. Lochman-Balk was elected a fellow of both the American Association for the Advancement of Science and the Geological Society of America, and was a member of the Paleontological Society, which awarded her its President's Citation in 1996.

Further Resources

New Mexico Institute of Mining and Technology. Faculty website. <http://www.ees.nmt.edu/balk/>.

Loeblich, Helen Nina Tappan

1917–2004

Paleontologist

Education: B.S., University of Oklahoma, 1937, M.S., 1939; Ph.D., geology, University of Chicago, 1942

Professional Experience: assistant geologist, University of Oklahoma, 1937–1939; instructor, Tulane University, 1942–1943; geologist, U.S. Geological Survey (USGS), 1943–1945, 1947–1959; research associate, paleontology, Smithsonian Institution, 1954–1957; lecturer, geology, University of California, Los Angeles (UCLA), 1958–1965, associate research geologist, 1961–1963, senior lecturer, geology, 1965–1966, professor, 1966–1984

Helen Loeblich was a renowned researcher in micropaleontology whose research focused on living and fossil foraminiferans, tintinnids, the camoebians, and organic-walled siliceous and calcareous phytoplankton. She was an assistant geologist at the University of Oklahoma before taking over her the teaching responsibilities of her husband, fellow paleontologist Al Loeblich, at Tulane University while he was on active military duty during World War II. After the war, she held positions with the USGS working at the Naval Petroleum Reserve in Alaska, and, with Al and their children, traveled to Europe on a Guggenheim Fellowship to conduct research on historical collections of forminifera for the Smithsonian Institution. The family relocated to California in 1957, where Al worked as a researcher for Chevron Oil and Helen returned to academia as a lecturer in geology at UCLA, where she eventually advanced to full professor and remained until her retirement in 1984.

With Al Loeblich she co-published more than 200 papers, articles, and books, and helped update the 1964 edition of *Treatise on Invertebrate Paleontology*. She received high praise for her 1980 book *The Paleobiology of Plant Protists*, and their joint 1987 two-volume work *Foraminifera Genera and Their Classification* was designated the best geography and earth science book of 1988 by the Association of American Publishers. Helen Loeblich was also an accomplished scientific artist who, in 1976, designed a stamp for the fiftieth-anniversary celebration of the Society of Economic Paleontologists and Mineralogists (now the Society for Sedimentary Geology).

Among the awards Helen Loeblich received were the Woman of Science Award from UCLA (1982), Paleontological Society Medal (1983), Raymond C. Moore Medal for Excellence in Paleontology (1984), and Woman of the Year Award in Natural History from the Palm Springs Desert Museum (1987). The Loeblich's were named honorary directors of the Cushman Foundation of Foraminiferal Research in 1982 and Helen Loeblich was elected president of the Paleontological Society in 1985. She was also a fellow of the Geological Society of America, an honorary member of the Society for Sedimentary Geology, and a member of the American Microscopical Society.

Further Resources

"In Memoriam: Helen Nina Tappan Loeblich." University of California, Los Angeles. <http://www.universityofcalifornia.edu/senate/inmemoriam/helenninaloeblich-tappan.html>.

Long, Irene (Duhart)

b. 1951

Aerospace Physician

Education: B.A., biology, Northwestern University, 1973; M.D., St. Louis University School of Medicine, 1977; M.S., aerospace medicine, Wright State University School of Medicine, Ohio, 1981

Professional Experience: medical resident, Ames Research Center, National Aeronautics and Space Administration (NASA), 1981-1982, John F. Kennedy Space Center, 1982; chief, Occupational Medicine and Environmental Health Office, NASA John F. Kennedy Space Center, 1982-1994, director, Biomedical Office, 1994-2000, Chief Medical Officer and Associate Director of Spaceport services, 2000-

Irene Long is one of the highest-ranking professional women at NASA. She was the first black female chief of the Occupational Medicine and Environmental Health Office, and is responsible for overseeing not only the health of the astronauts but also the health of some 18,000 workers, civil servants, and contractors at the Kennedy Space Center. She works with a team of physicians to provide medical services to the astronauts in emergency cases, such as an aborted mission, and she oversees inspecting workspaces at the Kennedy Space Center to protect employees from exposure to various possible hazards—toxic chemicals, fire, or decompression, for example—when a spacecraft is launched. She coordinates the efforts of the Department of Defense, environmental health agencies, and the astronaut office when they work together to stage successful launches, as well as to prepare for emergency situations. In her own research, Long has found that lower oxygen levels do not impede the flow of blood in people with the sickle-cell trait, and so they should not be banned from flying. She has also used the Johnson Space Center's collection of medical data to research the physical condition of astronauts, including the effects of space on the individuals' physiology and the consequences of weightlessness.

Long has also worked to encourage women and minorities to have careers in science and engineering through the Space Life Sciences Training Program. Participants in the program spend six weeks at the Kennedy Space Center studying space physiology in plants, animals, and humans, learning how to develop experiments, and becoming acquainted with the basic concepts of teamwork. Long received the Presidential Award of the Society of NASA Flight Surgeons (1995) and later served as president of the society (1998). She also received an Outstanding Achievement Award from Women in Aerospace (1998) and the Lifetime Achievement Award from the National Women of Color Technology Awards Conference (2005). Long is a member of the Aerospace Medical Association.

Further Resources

National Aeronautics and Space Administration. "Irene Duhart Long, M.D.: Chief Medical Officer and Associate Director, Center Operations." <http://www.nasa.gov/centers/kennedy/about/biographies/long.html>.

Long, Sharon (Rugel)

b. 1951

Developmental Biologist, Molecular Biologist

Education: B.S., biochemistry, California Institute of Technology, 1973; Ph.D., cell and developmental biology, Yale University, 1979

Professional Experience: research fellow, biology, Harvard University, 1978–1981; assistant to associate professor, biological science, Stanford University, 1982–1992, professor, 1992–

Concurrent Positions: investigator, Howard Hughes Medical Institute, 1994–2001; dean, School of Humanities and Sciences, Stanford University, 2001–2007



Developmental and molecular biologist, Sharon Long. (Courtesy of Stanford University News Service Library)

Sharon Long is renowned for her studies in plant genetics. Her research includes genetics and developmental biology of symbiotic nitrogen fixation in legumes, the role of plasmids in symbiosis, plant cell biology, and plant molecular biology. She identified and cloned the genes that allow bacteria to locate and enter certain plants; she has worked with the rhizobium bacterium that invades the roots of such legumes as alfalfa, soybeans, and peas, and lives symbiotically with the plant, receiving moisture and protection from it and producing nitrogen for the plant's growth. Her specific contribution is to genetically alter the bacterium to make better invaders. Her research involves allowing the bacterium to invade other major food crops,

which will enable farmers to reduce the amounts of nitrogen fertilizer that are spread on food crops and eventually are washed off by rain into streams and rivers.

Long was elected to membership in the National Academy of Sciences in 1993 and has had a distinguished career as a teacher, researcher, and administrator. After a postdoctoral fellowship at Harvard, she joined the faculty at Stanford University in 1982, serving as full professor since 1992, and was dean of the School of Humanities and Sciences for six years. At Stanford, she has twice received the Dean's Award for Distinguished Teaching (1988 and 1992). Among her prestigious national honors are a Presidential Young Investigators Award of the National Science Foundation (1984–1989) and a MacArthur fellowship (1992–1997). She has also been the recipient of a Shell Foundation Research Award, a Charles A. Schull Award from the American Society of Plant Physiology, a National Science Foundation Faculty Award for Women, and the Wilbur Cross Medal for alumni from Yale University (2002). She is a fellow of the American Association for the Advancement of Science, American Academy of Arts and Sciences, and American Philosophical Society. She is a member of the American Academy of Microbiology and a member of the Genetics Society of America, American Society of Plant Physiologists, American Society for Microbiology, and Society for Developmental Biology.

Further Resources

Stanford University. "Sharon R. Long Lab." <http://cmgm.stanford.edu/biology/long/>.

Love, Susan M.

b. 1948

Surgeon

Education: B.S., Fordham University, 1970; M.D., State University of New York Medical Center, 1974; M.B.A., Anderson School of Business, University of California, Los Angeles, 1998

Professional Experience: surgical intern, Beth Israel Hospital, Boston, Massachusetts, 1974–1975, surgical resident, 1975–1979, surgical coordinator, 1979, clinical fellow, pathology, 1980, assistant in surgery, Beth Israel Hospital, 1980–1987, director, Breast Clinic, 1980–1988, associate surgeon, 1987–1992, director of research, Faulkner Breast Center, 1992; clinical fellow, surgery, Harvard Medical School, Boston, 1977–1978, clinical instructor, 1980–1987, assistant clinical professor, surgery, 1987–1992; associate professor, clinical surgery, University of California, Los Angeles, 1992–1996, Revlon Chair in Women's Health, 1995–1996, director, Revlon/UCLA Breast Center, 1992–1996, adjunct associate



Surgeon Susan Love, 1996. She is the founder and director of the Dr. Susan Love Research Foundation for breast cancer research. (AP/Wide World Photos)

professor, 1996–1997, adjunct professor, general surgery, 1997–; president and medical director, Dr. Susan Love Research Foundation (formerly Santa Barbara Breast Cancer Institute), 1996–

Concurrent Positions: visiting registrar, Guy's Hospital, London, England, 1977–1978; clinical associate, Dana Farber Cancer Institute, 1981–1992

Susan M. Love is a surgeon who retired from medical practice to advocate for breast cancer research. She had a distinguished career as a physician, rising to become the first female general surgeon at Beth Israel Hospital in Boston and a professor at Harvard Medical School. She founded the National Breast Center Coalition in 1990 to bring together the latest research and political advocacy for greater awareness and more funding dedicated to breast cancer. She

moved to California in 1992 as a professor at the University of California, Los Angeles and served as director of the Revlon/UCLA Breast Center before founding the Dr. Susan Love Research Foundation in 1996. Love's work focuses on the lack of research funding, misinformation among doctors and patients, and concern about drastic and unnecessary treatment methods offered to women in the past, such as radical mastectomies. Her message to women diagnosed with breast cancer is that they should do their own research, be informed, get second opinions, and be their own advocates in the battle against the disease.

Love has published two books: *Dr. Susan Love's Breast Book* (1990; 4th ed., 2005) and *Dr. Susan Love's Menopause and Hormone Book* (1998; 2nd ed., 2003). She has contributed to numerous medical textbooks and has been a member of editorial or review boards of medical journals. Love's high-profile research center and popular books have made her a prominent public figure, and she has made several television appearances on Discovery Health channel, Lifetime, the *Oprah Winfrey Show*, *Good Morning America*, the *Today Show*, and other news programs. She lectures often for women's health groups and has served as a

Breast Cancer Research

Breast cancer is said to strike one in eight American women and, although more women die of heart disease and lung cancer each year, breast cancer is seen as a particularly insidious and dreaded disease among women. The fear of the disease stems, in part, from the historically brutal nature of the treatment. The first radical mastectomies were performed in the nineteenth century, with removal of the breasts, lymph nodes, and chest muscles. By the late twentieth century, as greater understanding of the course and spread of the disease was achieved, a greater range of treatments were offered, including surgery, radiation, and chemotherapy, but also new experimental drug options. Emotional support for the disease has also increased as patient advocacy groups have created support networks and called for earlier diagnosis, more humane treatments, increased research funding, and public campaigns such as the pink ribbon crusade and October as National Breast Cancer Awareness Month. Women scientists who have died of breast cancer include early-nineteenth-century British paleontologist Mary Anning, environmental scientist **Rachel Carson**, mathematician **Carol Karp**, and American physician **Jerri Nielsen**, who attracted worldwide media attention in 1998 after performing a lumpectomy on her own breast while stranded at the South Pole research center.

medical advisor or board member for the National Alliance of Breast Cancer Organizations, Lesbian Health Foundation, Wellness Community, International Breast Cancer Research Foundation, President's National Action Plan on Breast Cancer, and numerous other organizations. Her own research on breast ducts led to the co-founding in 1998 of a medical device company, now known as Pro-duct Health, for which she remains a consultant. In 2008, her own Dr. Susan Love Research Foundation joined with the Avon Foundation's "Army of Women" to support breast cancer awareness and research.

Love's numerous awards and honors include, but are not limited to, the following: Women Who Have Made a Difference by the International Women's Forum (1991), Achievement Award of the American Association of Physicians for Human Rights (1992), Women of Distinction by the National Council on Aging (1994), Spirit of Achievement Award from Albert Einstein College of Medicine, Yeshiva University (1995), Alumni Achievement Award from the State University of New York (SUNY) College of Medicine (1999), Radcliffe Medal of the Radcliffe College Alumnae Association (2000), Humanitarian of the Year Award of Western University of Health Sciences (2001), Excellence in Cancer Awareness Award from Congressional Families for Cancer Awareness (2002), Women Inspiring Hope and Possibility from the National Women's History Project (2004), Director's Award of the National Cancer Advisory Board and National Cancer

Institute (2004), and induction into the International Women's Forum Hall of Fame (2006). She has also received honorary degrees from several universities.

Love has been a member of the North American Menopause Society, American Medical Women's Association (branch president, 1987), American College of Surgeons, American Society of Clinical Oncology, American Association of Physicians for Human Rights, American Society of Preventive Oncology, Society for the Study of Breast Disease, American Association for Cancer Research, Association of Women Surgeons, American College of Women's Health Physicians (founding member), American College of Physicians Executives, Doctors against Abuse from Steroid Sex Hormones (DASH), Longmire Surgical Society, Massachusetts Medical Society, Los Angeles Medical Society, and Los Angeles Academy of Medicine. She is married to California surgeon Dr. Helen Sperry Cooksey.

Further Resources

Dr. Susan Love Research Foundation. <http://www.dsrlf.org/>.

Stabiner, Karen. 1998. *To Dance with the Devil: The New War on Breast Cancer*. NY: Delta Books.

Lubchenco, Jane

b. 1947

Marine Ecologist, Conservation Biologist

Education: B.A., biology, Colorado College, 1969; M.S., zoology, University of Washington, 1971; Ph.D., marine ecology, Harvard University, 1975

Professional Experience: assistant professor, ecology, Harvard University, 1975–1977; assistant to associate professor, zoology, Oregon State University, 1977–1988, professor and department chair, 1988–1992, distinguished professor, 1993–2009; Under Secretary of Commerce and Administrator, National Oceanic and Atmospheric Administration (NOAA), 2009–

Concurrent Positions: principal investigator, National Science Foundation, 1976–; visiting professor, University of the West Indies, Kingston, Jamaica, 1976; visiting professor, Discovery Bay Marine Lab, 1977; research associate, Smithsonian Institution, 1978–1984; visiting professor, Universidad Catolica, Santiago, Chile, 1986; visiting professor, Institute of Oceanography, Qingdao, China, 1987; visiting professor, University of Canterbury, Christchurch, New Zealand, 1995–1996, 1999–2000, and 2002–2003.

Jane Lubchenco is a marine ecologist interested in biodiversity and sustainable ecological systems, and is active in national and international studies in ecology and global climate change. In 2009, she was chosen by President Obama as head of NOAA, the first woman to hold that post. She had previously served on the National Science Board under President Clinton from 1996 to 2006 and advised the president, vice president, and U.S. Congress on issues related to climate change. Her work has focused on marine plant–herbivore interactions, chemical ecology, predator–prey interactions, algal ecology, and life histories. She is also interested in biodiversity and sustainable ecological systems. She conducted her early field research in Panama from 1977 to 1983. She helped draft the Sustainable Biosphere Initiative of the Ecological Society of America in 1991 and co-authored a 1997 article entitled “Human Domination of Earth’s Ecosystems,” in which the authors warned that human alteration of the Earth was substantial and growing.

She began her career at Harvard University, but after she and her husband, marine biologist Bruce A. Menge, had been married for several years, they sought joint employment at a research university where they could combine family and career. Oregon State University allowed them to split one tenure-track position into two separate, half-time tenure-track positions so that each of them could engage in research and work toward tenure while their children were young. As their children grew older, the couple were able to gradually move into full-time status, a model they actively endorse as an alternative for faculty with families. Some of her early papers were published under her married name, Jane Menge.

Lubchenco was elected to membership in the National Academy of Sciences in 1996 and is an elected member of the American Academy of Arts and Science (president, 1997), American Philosophical Society, and Royal Society. She is also a member of the Phycological Society of America, American Society of Naturalists, American Institute of Biological Sciences, International Council for Science, and Ecological Society of America (president, 1992–1993). She has served as advisor for numerous marine organizations including the Ocean Trust Fund, Environmental Defense Fund, and Monterey Bay Aquarium. She has received numerous honorary degrees as well as the Mercer Award of the Ecological Society of America (1979), a MacArthur Foundation “genius” fellowship (1993–1998), a Pew fellowship (1993), the Heinz Award for the Environment (2002), the American Association for the Advancement of Science (AAAS) Award for Public Understanding of Science and Technology (2005), and the Zayed International Prize for the Environment (2008).

Further Resources

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

National Oceanic and Atmospheric Administration. “NOAA Leadership: Dr. Jane Lubchenco.” <http://www.noaa.gov/lubchenco.html>.

Lubic, Ruth (Watson)

b. 1927

Nurse-Midwife

Education: diploma, School of Nursing Hospital, University of Pennsylvania, 1955; B.S., Teachers College, Columbia University, 1959, M.A., applied anthropology, 1961; certificate, nurse-midwifery, State University of New York at Brooklyn, 1962; Ed.D., applied anthropology, Columbia, 1979

Professional Experience: faculty member, School of Nursing, New York Medical College, and Maternity Center Association, State University of New York School of Nurse-Midwifery, Downstate Medical Center, 1955–1958; nurse, Memorial Hospital for Cancer and Allied Diseases, New York, 1955–1958; clinical associate, Graduate School of Nursing, New York Medical College, 1962–1963; general director, Maternity Center Association, New York, 1970–1995; founder, president, and co-CEO, District of Columbia Developing Families Center, 2000–

Concurrent Positions: consultant, midwifery, nursing, and maternal and child health, Office of Public Health and Science, U.S. Department of Health and Human Services, 1995–

Ruth Lubic is known for her contributions to the public health field, particularly those related to childbearing women, and has been a driving force behind the expansion of the midwifery profession in the United States. During her nursing training, Lubic observed that doctors often treated maternity patients with condescension and insensitivity, and that women often did not receive the prenatal and postnatal information they needed. These observations contrasted with her own experience in 1959, when her obstetrician allowed her husband to be present in the delivery room and to remain there with her and their newborn child for an hour after birth. For more than 25 years, she was director of the Maternity Century Association of New York, which was founded in 1918 as a nonprofit health agency dedicated to the advancement of education about childbearing and improving the care given to women during pregnancy and birth, and after delivery. Under Lubic’s direction, the Maternity Center Association open the nation’s first freestanding birth centers.

Lubic’s father was a pharmacist; after his death, her mother ran the pharmacy, and Ruth worked there to save money to enter nursing school at the age of 25.

Martha Ballard, Early American Midwife

Martha Moore Ballard (1735–1812) was a midwife and healer who, for more than 25 years, kept a detailed diary of her medical practice and domestic work in the frontier town of Hallowell, Maine. In addition to raising her own nine children and assisting her husband in the family business, Ballard contributed to her family income and community life as a midwife who delivered hundreds of babies and treated a variety of illnesses in her small town. Ballard's diary (which was recovered and published by historian Laurel Thatcher Ulrich in the 1991 Pulitzer Prize–winning book *The Midwife's Tale* and also inspired a documentary film and a student research website, <http://dohistory.org/>) reveals important information about childbirth and medicine in the late eighteenth and early nineteenth century, in particular highlighting the differences in obstetrical practice between midwives such as Ballard and a new class of professionally trained male doctors.

Interestingly, medicine seemed to be part of the female family legacy, as Martha Ballard's diary was eventually handed down to and preserved by a great-great-granddaughter, Mary Hobart, who in 1884 was one of the first American women to earn a medical degree and was the first woman admitted to the Massachusetts Medical Society.

She graduated from college in 1959 and went on to receive a certificate in nurse-midwifery from State University of New York at Brooklyn in 1962, but while working for the center, she realized that her limited knowledge of different cultures was barring her from responding adequately to the needs of some of her clients. Therefore, she entered the graduate program in applied anthropology at Columbia University's Teachers College and earned an educational doctorate (Ed.D.) in 1979. She had already become director of the Maternity Center Association in 1970. In 1993, she was the first nurse ever to be honored with a MacArthur Foundation grant (1993), which she used to open the District of Columbia Developing Families Center in 2000. The Center's stated goal is "to meet the primary health care, social service, and child development needs of underserved individuals and childbearing and childrearing families through a collaborative that builds on their strengths and promotes their empowerment."

Lubic received the Rockefeller Public Service Award from Princeton University (1981), the Lillian D. Wald Spirit of Nursing Award from the Visiting Nurse Service of New York (1994), and the Gustav O. Lienhard Award of the Institute of Medicine (2001). She is co-author of *Childbearing: A Book of Choices* (1987). She is a member of the Institute of Medicine of the National Academy of Sciences, the American Public Health Association, and the American College of Nurse-Midwives. She was

founder of the National Association of Childbearing Centers and served as that organization's president from 1983 to 1992.

Further Resources

Institute of Medicine of the National Academies. "Past Recipients of the Gustav O. Lienhard Award." <http://www.iom.edu/Activities/Quality/Lienhard/Past-Recipients.aspx>.

DC Developing Families Center. <http://www.developingfamilies.org/>.

Andrews, Wyatt. "The Midwife on a Mission." <http://www.cbsnews.com/stories/2008/09/08/eveningnews/main4428250.shtml>.

Lubkin, Gloria (Becker)

b. 1933

Physicist

Education: B.A., physics, Temple University, 1953; M.A., physics, Boston University, 1957

Professional Experience: mathematician, Aircraft Division, Fairchild Stratos Corporation, 1954, and Letterkenny Ordnance Depot, U.S. Department of Defense, 1955–1956; physicist, technical research group, Control Data Corporation, 1956–1958; acting chair, physics, Sarah Lawrence College, 1961–1962; vice president, Lubkin Associates, 1962–1963; associate to senior editor, *Physics Today*, 1963–1984, editor, 1985–1994, editorial director, 1994–2000, editor at large, 2001–2003

Gloria Lubkin has contributed to the physics profession in her 40-year career as editor of *Physics Today*, the publication of the American Institute of Physics. Her research includes nuclear physics and the history of physics, and in the 1960s, she began conducting oral histories of famous physicists. She is also an expert on science policy and has conducted several roundtables on issues in science that have been published in the journal, including issues of funding and scientists' relationship to government and to industry. Lubkin came to the journal with a solid background of experience. While working on her master's degree, she worked as a mathematician for Fairchild Stratos Corporation and the U.S. Department of Defense, and she was a physicist with Control Data Corporation before serving as acting chair of the physics department at Sarah Lawrence College. She joined the staff of *Physics Today* as an associate editor and rose through the ranks to editor and then editorial director before retiring emeritus in 2003.

Lubkin has served on numerous commissions and has received appointments to significant committees. She was a member of the Nieman Advisory Committee of

Harvard University (1978–1982) after being a recipient of a Nieman fellowship (1974–1975). In the American Physical Society, she has been a member of the executive commission of the Forum of Physics and Society (1977–1978) and a member of the executive committee of the History of Physics Division. She was also a consultant for the Center for the History and Philosophy of Physics of the American Institute of Physics (1966–1967). She was co-chair of the advisory commission for and co-founder of the Theoretical Physics Institute of the University of Minnesota (1987–1988), which now has a Gloria Becker Lubkin professorship of Theoretical Physics named in her honor.

Lubkin is a fellow of the American Physical Society and the American Association for the Advancement of Science, and a member of the New York Academy of Science and the National Association of Science Writers.

Luchins, Edith Hirsch

1921 | 2002

Mathematician

Education: B.A., Brooklyn College, 1942; M.S., New York University, 1944; Ph.D., mathematics, University of Oregon, 1957

Professional Experience: inspector, Sperry Gyroscope Company, New York, 1942–1943; instructor, mathematics, Brooklyn College, 1944–1946, 1948–1949; assistant, applied mathematics laboratory, New York University (NYU), 1946; research fellow and research associate, mathematics, University of Oregon, 1957–1958; research associate to associate professor, mathematics, University of Miami, Florida, 1959–1962; associate professor, Rensselaer Polytechnic Institute, New York, 1962–1970, professor, 1970–1992

Concurrent Positions: visiting professor, mathematics, U.S. Military Academy, West Point, 1991–1992, adjunct professor, cognitive sciences, 1994

Edith Luchins was recognized for her research on Banach algebras, functional analysis, and mathematical psychology. She was particularly interested in cognitive processes in mathematical problem solving, as well as the role of gender in learning and teaching mathematics. She especially wanted to encourage more women to pursue mathematics as a field of study. Luchins (then Hirsch) had emigrated to the United States from Poland when she was just six years old and, although (or because) neither parent had been formally educated, they stressed the importance of an education for Edith. In her New York City high school, she excelled in math, even tutoring other students and assisting teachers with grading.

Not only her family but her future spouse supported her education; Abraham Luchins insisted that she complete her undergraduate degree before they were married in 1942. She completed her bachelor's degree and then master's at NYU in quick succession, also teaching at Brooklyn College and working during World War II as a government inspector of anti-aircraft equipment at Sperry Gyroscope. Female mathematicians and scientists were in great demand in government and industry to fill in for men during the war.

Luchins had begun doctoral work at NYU but eventually took several years off from her studies to raise children and follow her husband's career to Montreal, Canada, and then to Oregon, where she finally received her doctorate from the University of Oregon in 1957 before giving birth to her fifth child. Her years in Canada were also important to her career, however, as she worked closely with her husband, an educational psychologist, and developed an interest in mathematics education that would influence her commitment to teaching and learning as well as research. Her collaborations with her husband also led the two to co-author several books. She taught at the University of Miami for four years before being appointed associate professor at Rensselaer Polytechnic in 1962, and in 1970 became the first woman promoted to full professor there. She formally retired in 1992 but remained active in her research until her death in 2002. She was a member of the Mathematical Association of America, the American Mathematical Society, the Society for Industrial and Applied Mathematics, the American Education Research Association, and the American Association for the Advancement of Science.

Further Resources

Murray, Margaret Anne Marie. 2000. *Women Becoming Mathematicians: Creating an Identity in Post World War II America*. Cambridge, MA: MIT Press.

Rensselaer Polytechnic Institute. "Obituary: Edith Luchins." http://www.rpi.edu/web/Campus.News/dec_02/dec_2/luchins.html.

Lucid, Shannon (Wells)

b. 1943

Biochemist, Astronaut

Education: B.S., chemistry, University of Oklahoma, 1963, M.S., 1970, Ph.D., biochemistry, 1973

Professional Experience: teaching assistant, chemistry, University of Oklahoma, 1963–1964; senior laboratory technician, Oklahoma Medical Research Foundation,



Astronaut Shannon Lucid exercises on a treadmill which has been assembled in the Russian Mir space station Base Block module, 1996. (NASA)

1964–1966; chemist, Kerr-McGee, 1966–1968; graduate assistant, biochemistry and molecular biology, University of Oklahoma Health Science Center, 1969–1973; research associate, Oklahoma Medical Research Foundation, 1974–1978; astronaut, National Aeronautics and Space Administration (NASA), 1978–1996; chief scientist, Solar System Exploration Division, Jet Propulsion Laboratory, 2002–2003, CAPCOM, mission control, Johnson Space Center, 2005–, management, Astronaut Office, 2008–

Shannon Lucid is a biochemist and astronaut who set the record for the most hours in space of any U.S. astronaut after she stayed aboard the Russian space station *Mir* for 179 days in 1996. Her task on the *Mir* was to conduct biomedical experiments on the effects of long-term space flight on humans. In addition her work on the space station, she flew as a mission specialist on the space shuttles *Discovery* (1985), *Atlantis* (1989), *Atlantis* (1991), and *Columbia* (1993). In 2002, Lucid became chief scientist of NASA's Solar System Exploration program, directing future space research and explorations and communicating NASA's missions to the public. Since 2005 she has served as CAPCOM (capsule communicator) for several space shuttle missions.

Lucid was born in Shanghai, China to missionary parents and was raised in Oklahoma. She earned both her undergraduate and graduate degrees in chemistry and biochemistry from the University of Oklahoma, receiving her doctorate in 1973. She then worked as a laboratory research associate at the Oklahoma Medical Research Foundation before joining the astronaut training program as part of the first group of women to be selected for the space program in 1978, along with **Judith Resnik, Sally Ride**, and others; Lucid was the only mother among the original group of female astronauts. During the 1980s, there was much publicity about the women astronauts, and their photos and interviews appeared in numerous magazines.

In 1996, Lucid was the first female astronaut to be awarded the Congressional Space Medal of Honor. She was recognized by Russian President Yeltsin in 1997 with the highest honor given to noncitizens, the Order of Friendship Medal.

Further Resources

Kevles, Bettyann H. 2003. *Almost Heaven: The Story of Women in Space*. New York: Basic Books.

National Aeronautics and Space Administration. "Shannon W. Lucid (Ph.D.)." <http://www.jsc.nasa.gov/Bios/htmlbios/lucid.html>.

Lurie, Nancy (Oestreich)

b. 1924

Anthropologist

Education: B.A., University of Wisconsin, Madison, 1945; M.A., University of Chicago, 1947; Ph.D., anthropology, Northwestern University, 1952

Professional Experience: instructor, anthropology and sociology, University of Wisconsin, Milwaukee, 1947–1949, 1951–1952; instructor, anthropology, University of Colorado, 1950; research associate, Peabody Museum, Harvard University, 1954–1956; lecturer, anthropology, Rackham School, University of Michigan, 1957–1959, lecturer, School of Public Health, 1959–1961, assistant professor, 1961–1963; associate professor, anthropology, University of Wisconsin, Milwaukee, 1963–1967, professor, 1967–1972; Anthropology Curator, Milwaukee Public Museum, 1972–1994, emerita

Concurrent Positions: American Association for the Advancement of Science grant, National Archives, 1953–1954; adjunct faculty member, University of Wisconsin, Milwaukee, 1972–1994

Nancy Lurie is a cultural anthropologist known for her studies of North American Indians and her work in applied and action anthropology aimed at identifying and solving community problems. Her work centered on the Winnebago or Ho-Chunk tribe of Wisconsin, and she was adopted by a member of that tribe, Mitchell Redcloud, Sr., whom she interviewed during the course of her graduate research. Her adoption gave her an entrée to Redcloud's family when she later conducted extensive research into the role of Native American women, who she felt were ignored in most histories of Native Americans. Her book, *Mountain Wolf Woman, Sister of Crashing Thunder* (1961), is the autobiography of one of Redcloud's family members, as Mountain Wolf Woman dictated it to Lurie, her adopted niece. As part of her activist anthropology, Lurie has also consulted with and served as an expert witness and researcher for Indian clients before the U.S. Indian Claims Commission on issues related to tribal identities, boundaries, land use, and occupancy.

As a child, Lurie's father took her to learn about American Indians at the Milwaukee Public Museum. As soon as she was old enough to ride the public transportation alone, she spent many hours at the museum and worked in the anthropology department as a volunteer. She conducted her first fieldwork among the Winnebago while still an undergraduate. There was very little information about this group available at the time, and she continued her research in graduate school. Her doctoral thesis compared cultural change in the Nebraska and Wisconsin enclaves of the Winnebago. During the late 1950s and early 1960s, she collaborated on research with **June Helm** on the northern Athabaskan Indians, studying the Dogrib settlements in the Canadian Northwest. Among her action anthropology projects, several involved the Winnebago and Menominee tribes. In 1972, she left the university and spent the next 20 years of her career as curator and head of the anthropology section of the Milwaukee Public Museum, the first woman to head one of the museum's scientific sections.

Lurie has received numerous honors and awards and is a fellow of the American Anthropological Association (president, 1983–1985) and a member of the American Association for the Advancement of Science, American Ethnological Society, and Society for Applied Anthropology. In 2004, the Ho-Chunk Nation formally recognized Lurie for her work on behalf of their people by presenting her with a custom-made blanket.

Further Resources

Gacs, Ute et al. 1988. *Women Anthropologists: Selected Biographies*. Westport, CT: Greenwood Press.

M

Maccoby, Eleanor (Emmons)

b. 1917

Psychologist

Education: student, Reed College, 1934, 1936; B.S., University of Washington, Seattle, 1939; M.A., University of Michigan, 1949, Ph.D., psychology, 1950

Professional Experience: study director, Division of Program Surveys, U.S. Department of Agriculture, 1943–1946; study director, Survey Research Center, University of Michigan, 1946–1948; lecturer and researcher, Laboratory of Human Development, Department of Social Relations, Harvard University, 1950–1958; associate professor, psychology, Stanford University, 1958–1966, professor, 1966–1987, emeritus

Eleanor Maccoby is a developmental and social psychologist whose studies of the social behavior of young children continue to influence research and theories of gender differences. She edited and wrote a chapter for *The Development of Sex Differences* (1966) on the differences in the development of male and female children, and, in particular, the reasons boys and girls perform differently on intellectual tests. In *The Psychology of Sex Differences* (1974), she and her co-author, Carol Nagy Jacklin, examined the research on gender differences and theorized that gender-typed behavior is a joint product of biological predispositions, social shaping, and cognitive self-socialization processes, and that there was no evidence for many widely held beliefs about the differences between boys and girls. The book was immediately controversial, but it was a first step toward more objective scientific investigations of sex differences. In *Social Development* (1980), she examined family socialization and argued that children's development is influenced by the nature and effect of parent-child interactions.

In the late 1980s, Maccoby and her team of researchers began a long-term study of the effect of divorce on young children. They followed 500 divorcing families for the book *Dividing the Child: Social and Legal Dilemmas of Custody* (1992; co-authored with legal scholar Robert Mnookin). Maccoby and her researchers followed up four years later when the children were adolescents and found that they did well as long as there was minimal parental conflict involved in joint-custody arrangements, results published in *Adolescents After Divorce* (1996; co-authored

with Christy M. Buchanan and Sanford M. Dornbusch). Maccoby again turned to her interest in sexual identity and gender differences in *The Two Sexes: Growing Up Apart, Coming Together* (1998), which explores how individuals express their sexual identity at successive periods of their lives and in different social contexts.

Maccoby's interest in psychology began in 1940 when she obtained a position doing public-opinion surveys for the Department of Agriculture. There she gained experience in applied psychology by conducting surveys of wartime programs such as fuel oil rationing and the sale of war bonds. She conducted research for her doctoral thesis in B. F. Skinner's laboratory at Harvard. Through the Laboratory of Human Development, she conducted interviews of mothers for a socialization study on childrearing practices. When the major investigator left the department, she was assigned to teach his courses in child psychology. After moving to Stanford University, she began her work on gender studies.

Maccoby was elected to membership in the National Academy of Sciences in 1993. She has received numerous prizes, such as the Distinguished Scientific Contributions Award of the American Psychological Association (1988), the Kurt Lewin Memorial Award (1991), and the Gold Medal Award for Life Achievement in Psychological Science of the American Psychological Association (1996). She is a member of the Society for Research in Child Development (president, 1981–1983), the American Psychological Association, the Social Science Research Council, and the American Academy of Arts and Sciences.

Macklin, Madge Thurlow

1893 1962

Geneticist

Education: A.B., Goucher College, 1914; M.D., Johns Hopkins University, 1919

Professional Experience: instructor, embryology, University of Western Ontario, 1921–1930, assistant professor, 1930–1945; research associate, Ohio State University, 1945–1959

Madge Macklin performed pioneering research in medical genetics, and she campaigned to include genetics in the standard medical school curriculum. Eventually, she was able to convince her contemporaries of the clinical importance of the family history in diagnosis, therapy, prognosis, and prevention of disease. She demonstrated that both environment and hereditary factors are significant in specific cancers, such as those of the stomach and breast. After her marriage in 1918 and receiving her M.D. from Johns Hopkins in 1919, she moved to the University of

Western Ontario as a lecturer in embryology classes for first-year medical students. Despite her significant work, she received only successive one-year appointments at Western Ontario, perhaps due to her controversial views on eugenics. She viewed eugenics as a branch of preventive medicine in that physicians should determine which people are physically and genetically qualified to be parents of the next generation. She advocated sterilization of people with certain mental diseases. Another factor for her short appointments was that her husband taught at the university, and many institutions were reluctant to hire both husband and wife as faculty, although they did not specifically forbid it.

Macklin was meticulous in her research in preparing carefully controlled experiments and data analysis. The contributions she made in applying sound statistical techniques to genetics were of great significance. In 1945, when she was notified that her contract at Western Ontario would not be renewed, she accepted a position at Ohio State as a National Research Council associate and as a lecturer in medical genetics. Her husband remained at Western Ontario. Macklin received an honorary degree from Goucher College in 1938, and the Elizabeth Blackwell Medal from the American Medical Women's Association in 1957. She was elected president of the American Society of Human Genetics in 1959.

MacLeod, Grace

1878 1962

Nutritionist

Education: B.S., chemistry, Massachusetts Institute of Technology, 1901; A.M., Columbia University, 1914, Ph.D., 1924

Professional Experience: teacher, Massachusetts public schools, 1901–1910; teacher, chemistry and physics, Pratt Institute, 1910–1917; assistant editor, *Industrial and Engineering Chemistry*, 1917–1919; instructor, nutrition, Teachers College, Columbia University, 1919–1924, assistant professor to professor, 1924–1944

Concurrent Positions: cooperating investigator, nutrition laboratory, Carnegie Institution, 1922–1928

Grace MacLeod was recognized by her contemporaries for her work in nutrition. Her research involved utilization of calcium and other supplements, efficiency of proteins, energy metabolism of children, and availability of iron. She spent nearly 25 years at Teachers College, Columbia University, building one of the outstanding nutrition programs in the United States. After the retirement of her colleague and former professor, **Mary Swartz Rose**, in 1940, MacLeod was the head of

the nutrition program. In 1944 and 1956, she helped revise and then co-author two new editions of Rose's book, *Foundations of Nutrition*, and she co-authored the fifth edition of Rose's *Laboratory Handbook for Dietetics*. During World War II, she worked on food and nutrition guidelines, becoming chair of the Food and Nutrition Council of Greater New York. After her formal retirement in 1944, she continued to consult for government agencies (such as the U.S. Department of Agriculture [USDA]) on children's nutritional and energy needs.

Born in Scotland, MacLeod came to the United States when she was only four years old. She majored in chemistry at the Massachusetts Institute of Technology (MIT) after being encouraged in science and math by her high school teachers. She went on to Columbia, but her career followed the general pattern for a woman of her generation. She taught public school for more than 10 years after receiving her undergraduate degree and then taught college chemistry and physics while working on her master's degree at Columbia. She spent two years as an assistant editor of a major journal in chemistry, *Industrial and Engineering Chemistry*, before joining the staff of Columbia University while she completed her doctorate. She rose through the academic ranks to full professor and did significant work in the field of nutrition, which was just being recognized as a profession, thanks in large part to the work of her team at Columbia. Her sister, Florence MacLeod, was also a nutritionist, working at the University of Tennessee.

MacLeod published numerous papers and articles, and was on the editorial board of the *Journal of Nutrition* and the *Journal of the American Dietetic Association*. She was a member of the American Association for the Advancement of Science, American Society of Biological Chemistry, American Chemical Society, Society of Biological Chemists, Society for Experimental Biology and Medicine, American Institution of Nutrition, American Dietetic Association, and American Home Economics Association.

Macy-Hoobler, Icie Gertrude

1892 1984

Chemist

Education: A.B., English and music, Central College for Women, Missouri, 1914; B.S., chemistry, University of Chicago, 1916; A.M., chemistry, University of Colorado, Boulder, 1918; Ph.D., physiological chemistry, Yale University, 1920

Professional Experience: assistant chemist, University of Colorado, Boulder, 1916–1917, physiological chemist, school of medicine, 1917–1918; assistant

biochemist, Western Pennsylvania Hospital, 1920–1921; instructor, University of California, Berkeley, 1921–1923; director, Nutrition Research Laboratory (later Research Laboratory of the Children's Fund of Michigan), Merrill-Palmer School, Detroit, Michigan, 1923–1954; staff, Merrill-Palmer Institute of Human Development and Family Life, 1954–1959, consultant, 1959–1974

Icie Macy-Hoobler was one of the most influential physiological chemists of the early twentieth century for her research on nutrition, mineral metabolism in human pregnancy, lactation, and growth, and the chemistry of red blood cells in health and disease. Her most important work was on the effect of nutrition on both mother and child. She studied the nutritional requirements of women and children and proved that malnutrition in women had a significant effect upon birth defects, and upon infant health and growth. As a graduate student at Yale, she began research on cottonseeds, which, during World War I, were being substituted for wheat flour. She found that animals that had been fed cottonseeds became ill due to gossypol, a poison present in the plant. She held a series of short-term positions at various schools while completing her advanced degrees and, after receiving her Ph.D., was offered the directorship of nutrition research at the Merrill-Palmer School in Detroit, which in 1931 became the Research Laboratory of the Children's Fund of Michigan. In this position, she mentored biochemistry and nutrition graduate students from the University of Chicago and other schools, and oversaw numerous important projects. Her research group was instrumental in showing the need for vitamin D and in encouraging the irradiation of milk. She studied amino acids in foods and the standardization and minimum daily requirements of vitamins B and C. Her work led to public health campaigns to disseminate new scientific information on nutrition to mothers and children. She contributed to hundreds of scientific papers and several books, including *Nutrition and Chemical Growth in Childhood* (3 vols., 1942–1951), *Hidden Hunger* (1945; co-authored with H. H. Williams), and *Chemical Anthropology: A New Approach to Growth in Children* (1957; co-authored with H. J. Kelly).

Icie Macy attended Central College for Women in Lexington, Missouri, where she studied English and received certification as a music teacher in order to please her parents. She went on to earn another bachelor's degree, this time in chemistry, from the University of Chicago in 1916, where she studied with Nobel Prize-winning physicist Robert A. Millikan. She earned a master's degree in chemistry from the University of Colorado, Boulder, where she taught inorganic and physiological chemistry. A professor encouraged her to continue on for a doctorate, and she enrolled at Yale University, where in 1920 she was one of the earliest women to earn a Ph.D. in physiological chemistry. She married late in life, to pediatrician Raymond Hoobler, in 1938.

Macy-Hoobler was the first woman to chair a division of the American Chemical Society—the biochemistry division (1930–1931). She was active in establishing the Women’s Award of the American Chemical Society, later known as the Garvan Medal, which she received in 1946. She also was awarded the Borden Award (1939), the Osborn and Mendel Award (1952), and the Modern Medicine Award (1955). She was a member of the American Association for the Advancement of Science, American Chemical Society, American Society of Biological Chemists, Michigan Academy of Arts, Sciences and Letters, American Institute of Chemists, and American Institute of Nutrition (president, 1944). She received honorary degrees from Wayne State University (1945) and Grand Valley State College (1971), and was inducted into the Michigan Women’s Hall of Fame. Macy-Hoobler published an autobiography, *Boundless Horizons: Portrait of a Woman Scientist* (1982), in which she related some of the difficulties she encountered as a woman in her long career.

Further Resources

Williams, Harold H. 1984. “Icie Gertrude Macy Hoobler (1892–1984): A Biographical Sketch.” *The Journal of Nutrition*. American Institute of Nutrition. 1351–1362. (30 April 1984). <http://jn.nutrition.org/cgi/reprint/114/8/1351.pdf>.

Makemson, Maud Worcester

1891–1977

Astronomer

Education: Radcliffe College, 1908–1909; A.B., astronomy, University of California, Berkeley, 1925, A.M., 1927, Ph.D., astronomy, 1930

Professional Experience: newspaper reporter, *Review* (Bisbee, Arizona) and *Gazette* (Phoenix, Arizona), 1917–1923; public school teacher, 1925–1926; research assistant, astronomy, University of California, Berkeley, 1926–1929, instructor, 1930–1931; assistant professor, astronomy and math, Rollins College, 1931–1932; assistant professor, Vassar College, 1932–1957, director of observatory, 1936–1957; research astronomer, University of California, Los Angeles, 1959–1964, lecturer, astronomy, 1960–1964

Concurrent Positions: Fulbright fellow, astronomy, Ochanomizu Women’s University, Tokyo, Japan, 1953–1954; consultant, Consolidated Lockheed–California, 1961–1963, General Dynamics, Fort Worth, Texas, 1965

Maud Makemson was recognized for her research on astrodynamics. Her research centered on celestial mechanics and astrodynamics, and on cultural topics such as Polynesian astronomy, navigation, and the Mayan calendar, subjects on which she

published in anthropological journals. She began her college career at Radcliffe, but after more than 10 years as a housewife and then newspaper reporter, she entered the University of California in 1923 as a divorced mother of three young children to complete her undergraduate degree. With the help of relatives to watch the children, she continued on to receive a Ph.D. in astronomy at Berkeley in 1930, with a focus on celestial mechanics. She taught briefly at Rollins College in Florida before accepting a faculty position at Vassar College in 1932. Makemson was the first professor of astronomy at Vassar who had not been a student of Maria Mitchell. Makemson remained at Vassar for 25 years, during which time she also became director of the observatory. She continued to work well into her seventies even after formal retirement. She held a position as a research astronomer and lecturer in astronomy at the University of California, Los Angeles after retirement from Vassar, and also consulted for Consolidated Lockheed in California and General Dynamics in Texas, where she moved in 1964 to be near one of her children. At the time of her death, she was still busy at work on a translation of a 1645 Latin astronomy text.

Makemson was co-author of *Introduction to Astrodynamics* (1961, 1967). In addition to her scientific papers, she wrote two other books: *The Morning Star Rises* (1941), on Polynesian astronomy, and *Book of the Jaguar Priest* (1951), for which she had received a Guggenheim fellowship to work on the translation and study of an ancient Mayan calendar. Both of these projects brought her prestige and recognition within the field. In 1953, she received a Fulbright fellowship to teach astronomy at Ochanomizu Women's University in Japan. She was elected a fellow of the American Association for the Advancement of Science and was a member of the American Astronomical Society, the American Institute of Aeronautics and Astronautics, and the American Association of Variable Star Observers.

Further Resources

Lankford, John and Ricky L. Slavings. 1997. *American Astronomy: Community, Careers, and Power, 1859–1940*. University of Chicago Press.

Maling, Harriet Mylander

1919–1987

Pharmacologist

Education: A.B., Goucher College, 1940; A.M., Radcliffe College, 1941, Ph.D., medical science and physiology, 1944

Professional Experience: assistant pharmacologist, Harvard Medical School, 1944–1945, instructor, 1945–1946; assistant professor, medical school, George Washington University, 1951–1952, assistant research professor, 1952–1954; pharmacologist, National Heart and Lung Institute, National Institutes of Health, 1954–1962, head, physiology section, 1962–retirement

Harriet Maling was a pharmacologist whose research focused on autonomic and cardiovascular drugs. She began her career plan as an undergraduate at Goucher College in Maryland, where she planned to combine her interests in medicine and biological research. She worked as an assistant pharmacologist and instructor at Harvard Medical School after receiving her doctorate in medical science and physiology from Radcliffe. During her final year of doctoral study, Maling received a fellowship from the American Association of University Women. She then took a five-year break from seeking employment, during which time she married and gave birth to four children. She returned to teaching at the medical school of George Washington University as assistant professor and later assistant research professor. She joined the National Heart and Lung Institute as a chemical pharmacologist in 1954, and began her research on the effects of different drugs on heart function. She was named the head of the division of physiology in 1962. She published dozens of scientific papers and was a member of the editorial board of the *Journal of Pharmacology and Experimental Therapeutics* from 1962 to 1965.

Maling was a member of the American Association for the Advancement of Science, the Society for Experimental Biology and Medicine, the American Society for Pharmacology and Experimental Therapeutics, and the New York Academy of Science.

Maltby, Margaret Eliza

1860 1944

Physicist

Education: A.B., Oberlin College, 1882, A.M., 1891; B.S., physics, Massachusetts Institute of Technology, 1891; Ph.D., University of Göttingen, 1895

Professional Experience: high school teacher, 1884–1887; instructor, physics, Wellesley College, 1889–1893, department head, 1896; instructor, physics and mathematics, Lake Erie College for Women, Ohio, 1897–1898; research assistant, Physikalisch-Technische Reichsanstalt, 1898–1899; instructor, chemistry, Barnard

College, 1900–1903, adjunct professor, physics, 1903–1910, associate professor and department head, physics, 1910–1931

Margaret Maltby was one of the earliest researchers in physical chemistry and the first American woman to receive a degree in physics from a German university. Her areas of research were measurement of high electrolytic resistances, measurement of periods of rapid electrical oscillations, conductivity of very dilute solutions of certain salts, and radioactivity. She was also interested in music and acoustics and is believed to have offered the first course in the physics of sound. During her lifetime, physics was almost exclusively a male profession, and Maltby worked at various institutions before securing a tenure-track faculty position at Barnard. After she graduated from Oberlin College, she attended the Art Students' League for a year before returning to Ohio to teach high school for four years. She entered the Massachusetts Institute of Technology (MIT) in 1887 to study physics and received her undergraduate degree in 1891, the same year that Oberlin granted her a master's degree. Besides earning these degrees, she also studied theoretical physics for a year at Clark University. She taught physics at Wellesley College for four years while continuing her graduate studies at MIT. She then was awarded a traveling fellowship to the University of Göttingen, where she received her doctorate in 1895. She returned to Wellesley as department head before accepting a position at Lake Erie College as instructor in physics and mathematics.

In 1900, Maltby came to Barnard to teach chemistry and physics, and spent the last 20 years of her career as head of the physics department. Although she had early success as a researcher, she never advanced to full professor at Barnard, perhaps because her teaching and administrative duties left little time for further research. She did, however, have a tremendous influence on a generation of female students of science, and committed a significant amount of time and energy to securing funding for equipment and for her students. She had an even greater role in developing career opportunities for women as chair of the fellowship committee of the American Association of University Women (AAUW) from 1913 to 1924, which gave funds to women for advanced study both in the United States and abroad. In 1926, the AAUW established a fellowship in her name. She contributed a chapter on "The Physicist" for a 1920 guide to *Careers for Women* (edited by Catherine Filene).

Maltby was elected a fellow of the American Physical Society, and she also was a member of the American Association for the Advancement of Science.

Further Resources

Byers, Nina and Gary A. Williams. 2006. *Out of the Shadows: Contributions of Twentieth-Century Women to Physics*. New York: Cambridge University Press.

Marcus, Joyce

Archaeologist

Education: B.A., University of California, Berkeley, 1969; M.A., Harvard University, 1971, Ph.D., anthropology, 1974

Professional Experience: visiting lecturer, anthropology, University of Michigan, Ann Arbor, 1973–1975, visiting assistant professor, 1975–1976, assistant professor, anthropology, 1976–1981, assistant curator, Latin American Archaeology, University of Michigan Museum of Anthropology, 1978–1981, associate professor and associate curator, 1981–1984, professor, anthropology, and curator, Latin American Archaeology, 1985–, Elman R. Service Professor of Cultural Evolution, 1998–2005, Robert L. Carneiro Distinguished University Professor of Social Evolution, 2005–

Joyce Marcus is an archaeologist whose research interests include the social, political, and economic development of ancient societies in Latin America. Her primary research has focused on the Zapotec, Maya, and pre-Inca societies of ancient Mexico, Guatemala, and Peru. She has combined archaeological fieldwork with hieroglyphic and ethnohistoric sources to analyze how these civilizations evolved over time, and has documented the emergence of the earliest villages, hereditary inequality, social stratification, warfare, and state religion. She and her colleagues have excavated one of Mexico's earliest agricultural villages and the earliest appearance of hieroglyphic texts circa 700 to 650 BC.

Born in California, Marcus completed her undergraduate education at the University of California, Berkeley and went on to receive her doctorate in anthropology from Harvard University in 1974. She has spent her entire teaching career at the University of Michigan in Ann Arbor, where she is also the Curator of Latin American Archaeology for the Museum of Anthropology. She has published numerous articles and books, including *The Cloud People: Divergent Evolution of the Zapotec and Mixtec Civilizations* (1983, with Kent Flannery; new ed., 2003), *Mesoamerican Writing Systems: Propaganda, Myth, and History in Four Ancient Civilizations* (1992, an Honorable Mention for Outstanding Book in the Social Sciences and Humanities by the Latin American Studies Association), *Zapotec Civilization: How Urban Society Evolved in Mexico's Oaxaca Valley* (1996, with K. Flannery), *Women's Ritual in Formative Oaxaca: Figurine-Making, Divination, Death and the Ancestors* (1998), *La Civilización Zapoteca: Como Evolucionó La Sociedad Urbana en el Valle de Oaxaca* (2001, with K. Flannery, recipient of the Premio Caniem 2001 en el Arte Editorial award in Mexico), *Agricultural Strategies* (2006, with Charles Stanish), *Monte Albán* (2008), *Excavations at*

Cerro Azul, Peru: The Architecture and Pottery (2008, awarded the Cotsen Book Prize in archaeology), *The Ancient City* (2008, with Jeremy A. Sabloff), and *Andean Civilization* (2009, with Ryan Patrick Williams).

Marcus has been an invited lecturer at institutions both in the United States and abroad, and has been a consultant to the American Museum of Natural History in New York; University Museum, University of Pennsylvania; Cotsen Institute of Archaeology, University of California, Los Angeles; and Harvard University's Peabody Museum. She has received numerous grants for her research, including from the Ford Foundation, the National Endowment for the Humanities, the American Association of University Women, and the National Science Foundation.

Marcus was elected to the National Academy of Sciences in 1997 and was the first archaeologist to be elected to the Council of the National Academy of Sciences (2005–2008). She is an elected fellow of the American Academy of Arts and Sciences, American Philosophical Society, and Institute of Andean Studies, and a member of the American Anthropological Association, Society for American Archaeology, American Society for Ethnohistory, Midwest Andeanist Society, and Midwest Mesoamericanist Society. The University of Michigan has acknowledged her research and teaching with the Henry Russel Award for Scholarly Research (1979), a Literature, Science, and Arts Excellence in Research Award (1995), and a Distinguished Faculty Achievement Award (2007). The Universidad Autónoma de Campeche awarded Marcus a "special recognition" Reconocimiento (2003), and she received a Mentor Recognition Award from the University of California, San Diego (2007).

Further Resources

University of Michigan. Faculty website. http://www.lsa.umich.edu/anthro/faculty_staff/marcus.html.

Margulis, Lynn (Alexander)

b. 1938

Cell Biologist, Microbiologist

Education: B.A., University of Chicago, 1957; M.S., University of Wisconsin, 1960; Ph.D., genetics, University of California, Berkeley, 1965

Professional Experience: postdoctoral researcher, Brandeis University, 1963–1965; assistant professor, biology, Boston University, 1966–1971, associate professor, 1971–1977, professor, 1977–1988, Distinguished University Professor of



Cell biologist and microbiologist, Lynn Margulis. (Courtesy of the University of Massachusetts)

Biology, 1986–1988; Distinguished University Professor of Geosciences, University of Massachusetts, Amherst, 1988–

Concurrent Positions: chair, Space Science Board Committee on Planetary Biology and Chemical Evolution, National Academy of Science, 1977–1980

Lynn Margulis has been called the most gifted theoretical biologist of her generation, and she has questioned accepted truths about evolution, heredity, and cell biology. Her research on evolutionary links between cells containing nuclei and cells without nuclei led her to formulate a symbiotic theory of evolution in the 1970s that finally is becoming more widely accepted in the scientific community. Prior to her

work, scientists held that evolution was based on natural selection. Her theory of symbiosis proposes that eukaryotes (cells with nuclei) evolved when different kinds of prokaryotes (cells without nuclei) formed symbiotic systems to enhance their chances for survival. The first such symbiotic fusion would have taken place between fermenting bacteria and oxygen-using bacteria. All cells with nuclei, she theorizes, are derived from bacteria that formed symbiotic relationships with other primordial bacteria some 2 billion years ago. She argues that the primary mechanism driving biological change is symbiosis and that competition plays a secondary role. The manuscript in which she first presented her symbiotic theory was rejected or lost by 15 journals before it was published in the *Journal of Theoretical Biology* in 1966. Her comprehensive exposition of the theory is presented in the book *The Origin of Eukaryotic Cells* (1970), and the revised version was published as *Symbiosis in Cell Evolution* (1981). By the time the second book was published, the scientific establishment had finally accepted the idea that mitochondria and chloroplasts evolved symbiotically.

Another of Margulis's current theories that has not yet been accepted is that the Earth as a whole is alive. This idea is popularly known as "the Gaia hypothesis," named for the Greek goddess of the Earth and first proposed by the chemist James Lovelock. Margulis provided evidence for this theory in her research on protozoa,

algae, seaweeds, molds, and microbes that prompted *Omni* magazine to dub her “the wizard of ooze” in 1985. When Margulis was elected to membership in the National Academy of Sciences in 1983, she viewed the honor as an indication that her theories were being accepted by the scientific community.

Margulis has published numerous books, including *Symbiotic Planet: A New Look at Evolution* (1998), and several books with her son, Dorion Sagan, such as *What Is Life?* (1995), *What Is Sex?* (1997), and *Acquiring Genomes: A Theory of the Origins of Species* (2002). In 2006, she and Dorion founded their own publishing company, Sciencewriters Books. Her 2007 book, *Mind, Life, and Universe: Conversations with Great Scientists of Our Time* (co-edited with Eduardo Punset), includes profiles of several other women scientists.

In 1999, Margulis was awarded both the National Medal of Science and the Proctor Prize for scientific achievement. In 2009, she was awarded the Darwin-Wallace Medal of the Linnean Society of London for “major advances in evolutionary biology.” She is a fellow of the American Association for the Advancement of Science and a member of the International Society for the Study of the Origin of Life and International Society for Evolutionary Protistology (“protistology” refers to the taxonomic kingdom of protists such as protozoans, eukaryotic algae, and slime molds). She was married to physicist and popular author Carl Sagan, and her early work was published under the name Lynn Sagan. She was married a second time, to crystallographer Thomas Margulis, but the couple later divorced.

Further Resources

University of Massachusetts. Faculty website. <http://www.geo.umass.edu/faculty/margulis/>.

Marlatt, Abby Lillian

1869 1943

Home Economist and Educator

Education: B.S., Kansas State Agricultural College, 1888, M.S., chemistry, 1890

Professional Experience: head, domestic economy, Utah State Agricultural College, 1890–1894; high school teacher, home economics, 1894–1909; director, home economics department, University of Wisconsin, 1909–1935

Abby Marlatt helped develop the profession of home economics by insisting upon broad training and high standards. Her department at the University of Wisconsin became the model for other home economics programs around the country. After

she received her master's degree from Kansas State Agricultural College, Marlatt was invited to establish a program in domestic economy at Utah State. In 1894, she accepted a position to establish a program at the Manual Training High School in Providence, Rhode Island. She took advantage of the location by enrolling in advanced studies at Clark University and Brown University. In 1909, the dean of agriculture at the University of Wisconsin invited her to revitalize the school's home economics program. Under her management, the department rapidly expanded in number of courses, students, and faculty. She also established high academic standards for her students, requiring courses in English, foreign languages, and science, and offering technical courses including bacteriology, physiology, and journalism. Her program greatly broadened the training available to home economics majors beyond the domestic skills courses that many colleges offered.

During World War I, Marlatt served in the food-conservation division of the U.S. Department of Agriculture and on several other federal committees. In 1903, she was chair of the Lake Placid Conference on Home Economics and was instrumental in continuing the conference series. After the group was established as the American Home Economics Association, she was vice president from 1912 to 1918. She also directed two fundraising campaigns for the association. She was a member of the American Chemical Society and the American Association for the Advancement of Science. She received honorary degrees from Kansas State in 1925 and from Utah State in 1938.

Marrack, Philippa Charlotte

b. 1945

Immunologist

Education: B.A., Cambridge University, 1967, Ph.D., biological sciences, 1970

Professional Experience: postdoctoral fellow, molecular biology, Cambridge University, 1970–1971; postdoctoral fellow, biology, University of California, San Diego, 1971–1973; postdoctoral fellow, microbiology, University of Rochester, New York, 1973–1974, associate, 1974–1975, assistant professor, microbiology, 1975–1976, assistant professor, oncology, microbiology and cancer center, 1976–1979, associate professor, 1979–1982; associate professor, biophysics, biochemistry, and genetics, University of Colorado Health Science Center, 1980–1985, professor, biochemistry and molecular genetics, 1985–, professor, microbiology and immunology, 1988–1994, professor, immunology, 1994–

Concurrent Positions: investigator, American Heart Association, 1976–1981; member, Department of Medicine, National Jewish Health Center, 1979–; head, Division of Basic Immunology, National Jewish Center of Immunology and Respiratory Medicine, 1988–1990 and 1998–1999; investigator, Howard Hughes Medical Institute, 1986–; advisory head, research in allergy/asthma, National Jewish Health Center, 2004–2006

Philippa Marrack is renowned for her research on the body's immune system and the intricate web of defenses it raises against viruses, bacteria, and other trespassers. Her particular interest is how the body accepts or rejects its own tissues, which is the study of the "T cells" formed in the thymus gland that control the immune system, and her work has implications for the development of vaccines. Very little was known about the T cells in the immune system until the late 1960s, and Marrack and her husband, John Kappler, who have worked together for more than 30 years, became the leading scientists conducting this research.

Born in England, Marrack began her research while still a graduate student at Cambridge University. After receiving her doctorate, she moved to the University of California, San Diego as a fellow in immunology. She joined the cancer research laboratory of R. W. Dutton, who had recently learned to grow cultures of T lymphocytes, and there she met John Kappler, who also was working in the laboratory. They married in 1974 and moved to the University of Rochester, where she was a postdoctoral fellow in immunology. After she won an American Heart Association investigatorship to do basic research, she was recognized as an equal partner with Kappler and the two began to pursue joint projects and publish together. They established a system whereby the person who performed the principal experiments is always the first listed author, and the one who primarily wrote the paper is named second. They moved to Denver, Colorado, in 1979, where they both hold joint appointments with the University of Colorado Health Sciences Center and National Jewish Health. They are also investigators for the Howard Hughes Medical Institute.

Marrack and Kappler have received numerous awards and honors from international organizations and universities for their research; most recently, she is the recipient of the American Association of Immunologists Lifetime Achievement Award (2002), the L'Oréal-UNESCO Women in Science Award (2004), and the National Jewish Health Presidential Award (2004). She is a member of the Royal Society, the American Association of Immunologists (vice president, 1999–2000; president, 2000–2001), and the Science Council of the American Heart Association. She was elected to the National Academy of Science in 1989 and to the Institute of Medicine in 2008.

Further Resources

Howard Hughes Medical Institute. "Philippa Marrack, Ph.D." http://www.hhmi.org/research/investigators/marrack_bio.html.

Martin, Emily

b. 1944

Anthropologist

Education: B.A., anthropology, University of Michigan, B.A., 1966; Ph.D., Cornell University, 1971

Professional Experience: assistant professor, anthropology, Program in Comparative Culture, University of California, Irvine, 1971–1972; assistant professor, anthropology, Yale University, 1972–1974; associate professor, Johns Hopkins University, 1974–1976, professor, 1976–, Mary Elizabeth Garrett Professor of Arts and Sciences, 1981–1994; professor, anthropology, Princeton University, 1994–2001; professor, anthropology, New York University, 2001–

Emily Martin is a cultural anthropologist whose research interests include religion, ideology, politics, models and explanations in social anthropology, political economy of health, gender, anthropology of science, rationality, psychiatry, the unconscious, anthropology of science and medicine, gender, cultures of the mind, emotion and rationality, history of psychiatry and psychology, and both Chinese and U.S. culture and society. Martin began her anthropological research in China and published several books on Chinese religion, ritual, and rural society. She became interested in issues related to science and gender, and her 1987 book, *The Woman in the Body: A Cultural Analysis of Reproduction*, won the Eileen Basker Memorial Prize. She continued this work in a pathbreaking 1991 article, "The Egg and the Sperm: How Science Has Constructed a Romance Based on Stereotypical Male-Female Roles," which highlighted how the language of gender influences scientific research and findings; the article has become a classic in feminist science criticism. Her interest in the cultural anthropology of science and medicine led to the publication in 1994 of *Flexible Bodies: Tracking Immunity in American Culture from the Days of Polio to the Age of AIDS*, and her 2007 book, *Bipolar Expeditions: Mania and Depression in American Culture*.

Martin taught at Yale, Johns Hopkins, and Princeton universities; since 2001, she has been a professor of anthropology at New York University (NYU) and is affiliated with the NYU Institute for the History of the Production of Knowledge. Always interested in the connections between science and culture, Martin has been

involved in a variety of projects linking academic anthropology to broader issues of interest to the general public and to practitioners in other sciences. She is founding editor of the magazine *Anthropology Now* and is one of the organizers of an interdisciplinary program called the Psycences Project, which brings together scholars in the humanities and social sciences with clinicians in psychology and psychiatry to discuss research on the human mind across these fields.

Martin has been a distinguished invited lecturer and visiting scholar at many institutions and is a member of the American Anthropological Association, American Ethnological Society, Royal Anthropological Institute, Society for Medical Anthropology, and Association for Feminist Anthropology. Some of her early works were published under the name Emily Martin Ahern.

Further Resources

New York University. Faculty website. <http://anthropology.as.nyu.edu/object/emilymartin.html>.

Marvin, Ursula Bailey

b. 1921

Planetary Geologist

Education: B.A., history, Tufts University, 1943; M.S., geology, Harvard University–Radcliffe, 1946, Ph.D., 1969

Professional Experience: assistant silicate chemist, University of Chicago, 1947–1950; mineralogist, Union Carbide Ore Company, 1953–1958; instructor, mineralogy, Tufts University, 1958–1961; geologist, Smithsonian Astrophysical Observatory (now the Harvard-Smithsonian Center for Astrophysics), Harvard University, 1961–1998, senior geologist emeritus

Concurrent Positions: lecturer, Tufts University, 1968–1969; lecturer, geology, Harvard University, 1974–1977

Ursula Marvin has been a prominent planetary geologist whose research interests include mineralogy and petrology of meteorites and lunar samples, history of geology, and geological mapping of Galilean satellites. She received a master's degree in 1946, and for many years, she and her husband, Thomas Crockett Marvin, were independent geologists and mineralogists who worked throughout the world. She did not return to Harvard to complete her Ph.D. until 23 years after completing the required course work at Harvard. One of her early projects involved traveling to Brazil to locate manganese oxide to be used in batteries

manufactured by the Union Carbide Company. She also worked as a chemist at the University of Chicago and as an instructor in mineralogy at Tufts University. She has had concurrent positions with the Smithsonian Astrophysical Observatory (or SAO; now the Harvard-Smithsonian Center for Astrophysics, or CfA), the Harvard College Observatory, and as a lecturer with Tufts and Harvard, where she was the first female faculty member in geology. She began studying meteorites at the Harvard-Smithsonian CfA in 1961, and remained there until her retirement in 1998.

At the CfA, Marvin worked on a NASA study of the mineral makeup of lunar rocks brought back by the Apollo astronauts. Her space work also included the geological mapping of Jupiter's largest satellite or moon, Ganymede. During two polar expeditions as part of the National Science Foundation's (NSF) Antarctic Search Meteorites Team in 1978–79 and 1981–82, she collected and studied meteorites, sending samples to other scientists around the world. She returned to Antarctica in 1985 as part of an NSF team to research the boundary and impact of the meteor that may have led to the extinction of the dinosaurs 65 million years ago. Her work on these various projects was acknowledged with both an asteroid (1991) and an ice mountain, or "nunatak," (1992) named in her honor.

Even after her formal retirement in 1998, Marvin has remained affiliated with the CfA as a consultant, senior geologist emeritus, and consulting expert. She has been particularly involved in advancing the careers of women in science. Between 1974 and 1977, she was the first coordinator of the Federal Women's Program (now the Women's Program Committee) at the SAO. She served on the American Geological Institute's Committee of Women in the Geosciences, for which she compiled and edited the annual *Roster of Women in the Geosciences Professions*. She has dedicated her time to a variety of academic and professional committees dedicated to science education, including as a trustee of Tufts University (1975–1985), a trustee of the Universities Space Research Association (USRA) (1979–1984), and secretary-general of the International Commission on the History of Geological Sciences (1989–1996; vice president for North America, 1996).

Marvin was the honored recipient of the History of Geology Award in 1986 from the Geological Society of America (GSA). In 1997, Marvin received Lifetime Achievement Awards from Women in Science and Engineering (WISE) and the Harvard-Smithsonian Center for Astrophysics. In 2005, she received the Sue Tyler Friedman Award of the GSA for work in recording the history of geology. She has been a member of the Mineralogical Society of America, the Meteoritical Society (president, 1975 and 1976), History of Earth Sciences Society (president, 1991), American Association for the Advancement of Science, and American Geophysical Union.

Further Resources

“Ursula Marvin Honored by ‘Wise’ Award for Lifetime Achievement in Science.” *CfA Almanac*. (July 1997). <http://www.cfa.harvard.edu/lib/online/almanac/797.htm>.

Mathias, Mildred Esther

1906–1995

Botanist

Education: A.B., Washington University, St. Louis, 1926, M.S., 1927, Ph.D., botany, 1929

Professional Experience: assistant, Missouri Botanical Garden, 1929–1930; research associate, New York Botanical Garden, 1932–1936; research associate, University of California, Berkeley, 1937–1942; herbarium botanist, University of California, Los Angeles (UCLA), 1947–1951, lecturer, botany, 1951–1955, assistant professor to professor, 1955–1974; director, Botanical Garden, UCLA, 1956–1974

Concurrent Positions: assistant specialist, experiment station, UCLA, 1951–1955, assistant plant systematist, 1955–1957, associate plant systematist, 1957–1962

Mildred Mathias was a prominent, award-winning botanist whose research included classification of plants of the western United States, subtropical ornamental plants, and tropical medicinal plants. She was an expert on Umbelliferae, or the carrot family, of which she discovered 100 new species or combinations; the genus *Mathiasella* is named in her honor. Mathias had originally planned to study mathematics, but few courses were available to women when she began her studies in the early 1920s. She went on to complete her bachelor's, master's, and doctorate in botany at Washington University in St. Louis. She worked at the Missouri Botanical Garden and the New York Botanical Garden before moving to California as a research associate at Berkeley in 1937. She began her work at UCLA in 1947 as a herbarium botanist, then serving on the faculty until her retirement in 1974. Mathias was married and the mother of four children, which was unusual for a career woman of her generation.

Beyond her research and teaching, Mathias was committed to educating the public about horticulture and to conservation. She was director of the UCLA botanical garden for almost 20 years, and in 1979, it was renamed the Mildred E. Mathias Botanical Garden in her honor. In addition to her work at the botanical garden, she co-hosted a weekly gardening show on television and wrote articles

on horticulture and gardening for popular magazines. She worked to protect lands from development at the local, national, and international level, helping to establish the U.S. Natural Reserve System and founding the Organization for Tropical Studies to preserve lands in Costa Rica. She was the author of *Color for the Landscape: Flowering Plants for Subtropical Climates* (1973).

Mathias was named Woman of the Year by the *Los Angeles Times* in 1964, and her numerous other honors include the Nature Conservancy National Award, the California Conservation Council Merit Award, the UCLA Medical Auxiliary Woman of Science Award, a Merit Award from the Botanical Society of America (1973), the Liberty Hyde Bailey Medal from the American Horticultural Society (1980), a Medal of Honor from the Garden Club of America (1982), and the UCLA Emeritus of the Year Award (1990). She served as executive director of the American Association of Botanical Gardens and Arboretums, and was a member and president of both the American Society of Plant Taxonomists (president, 1964) and the Botanical Society of America (president, 1984). She was also a member of the Society for the Study of Evolution, American Association for the Advancement of Science, and the American Society of Naturalists. In 1996, the Botanical Garden at UCLA produced a video about her life and work entitled *Mildred Mathias: A Lifetime of Memories*.

Further Resources

University of California, Los Angeles. "Mildred E. Mathias Botanical Garden." <http://www.botgard.ucla.edu/bg-home.htm>.

Matson, Pamela Anne

b. 1953

Soil Scientist, Environmental Scientist

Education: B.S., biology and English, University of Wisconsin, Eau Claire, 1975; M.S., environmental science, Indiana University, 1980; Ph.D., forest ecology, Oregon State University, 1983

Professional Experience: postdoctoral fellow, entomology, North Carolina State University, 1983; research scientist, Ames Research Center, National Aeronautics and Space Administration (NASA), 1983–1993; professor, ecosystem ecology, University of California, Berkeley, 1993–1997; professor, geological and environmental studies, Stanford University, 1997–

Pamela Matson is renowned for her pioneering research into the role of land-use changes on global warming. She has analyzed greenhouse gas emissions resulting

from tropical deforestation and investigated the negative effects of intensive agriculture on the atmosphere, especially the effects of tropical agriculture and cattle ranching. After receiving her doctorate in biology in 1975, her early research focused on forest ecology and then broadened to include many other areas in the global environment. She worked as a research scientist for NASA for 10 years before entering academia as a full professor at the University of California, Berkeley. In 1997, she moved to Stanford as professor of environmental studies, where she has served as Dean of Earth Sciences since 2002.

Matson has served on numerous boards and committees dedicated to conservation, ecology, and the study of the environment and global climate change. She is the founding editor-in-chief of the *Annual Review of Environment and Resources* (2002–present) and has served on the editorial board of numerous other journals, including *Ecosystems*, *Biogeochemistry*, and *Global Change Biology*. She has published nearly 100 papers and book chapters, and is co-editor of *Biogenic Trace Gases: Measuring Emission from Soil and Water* (1995) and *Principles of Terrestrial Ecosystem Ecology* (2002).

In 1994, she was elected to the National Academy of Sciences, and in 1995 she received the prestigious five-year MacArthur fellowship. Among her numerous other awards and honors are the NASA Exceptional Service Award (1993), the University of Wisconsin, Eau Claire Distinguished Alumni Award (1996), the Oregon State University Distinguished Alumni Award (1998), and a McMurtry Fellowship in Undergraduate Education at Stanford (2002). She has served on numerous professional boards and government committees on sustainability and environmental issues, and has been named a National Associate of the National Academy of Sciences (2002). She is a member of the American Academy of Arts and Sciences, Ecological Society of America (president, 2001), American Association for the Advancement of Science, American Geophysical Union, American



Environmental scientist Pamela Anne Matson. (Courtesy of Stanford University News Service Library)

Institute of Biological Sciences, and American Association of University Women. In 2000, she was named a Fellow of the Aldo Leopold Leadership Program at Stanford University.

Further Resources

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

Stanford University. Faculty website. <http://pangea.stanford.edu/research/matsonlab/members/Matson.htm>.

Matthews, Alva T.

b. 1933

Engineer

Education: B.S., Columbia University, 1955, M.S., 1957, Ph.D., engineering science, 1965

Professional Experience: design and research engineer, Weidlinger Associates, 1957–1983; senior research engineer, Rochester Applied Science Associates, 1957–1983; independent consultant, 1983–

Concurrent Positions: instructor, civil engineering, Columbia University; adjunct associate professor, mechanical and aerospace sciences, University of Rochester; instructor, engineering, Swarthmore

Alva Matthews is a research engineer recognized for her work in the field of structural analysis and wave propagation in solids. She designed helicopter blades and satellite-tracking antennae, and analyzed auto accidents in order to learn how to build safer cars. As a wave-propagation specialist, she has studied earthquakes to see how shock waves are transmitted through soil and rocks, and how buildings can be designed to withstand earth tremors. Her work had implications for studies of the effect of nuclear weapons on structures such as buildings. After receiving her master's degree, she was employed at Weidlinger Associates, a construction engineering firm in New York. She was concurrently a senior research engineer with Rochester Applied Science Associates in Rochester, New York. At the same time, she was an instructor of civil engineering at Columbia and lectured in the evenings at the University of Rochester.

Matthews decided to become an engineer while still a teenager when she accompanied her father, an industrial builder, to construction sites. She began her college education at Middlebury College in Vermont, then transferred to Barnard before moving on to Columbia University. As a student worker in a

contractor's field office, she was prohibited from entering the tunnels with the men, and an early advisor at Middlebury told her engineering was too difficult for a girl and she would never find a job. She ignored this advice, and went on to earn three engineering degrees from Columbia, including becoming the first woman to receive a doctorate in civil engineering from that institution. She dedicated herself to promoting engineering education and careers for women; in 1973, she spoke before the Society of Women Engineers on "Engineering as an Ideal Woman's Career." After starting her own family in the late 1970s, Matthews retired from her full-time engineering position, but remained a private consultant and adjunct instructor of engineering sciences at various colleges.

Matthews is a member of the American Society of Mechanical Engineers and has been honored with the Society of Women Engineers Achievement Award (1971) and the Engineering Award of the Federation of Engineering and Scientific Societies of Drexel University (1976). In 2005, she was appointed to the Dean's Engineering Council at Columbia. She is identified in some sources by her married name, Alva Matthews Solomon.

Further Resources

Alva Matthews. The Society of Women Engineers. http://societyofwomenengineers.swe.org/index.php?option=com_content&task=view&id=49&Itemid=55.

Hatch, Sybil E. 2006. *Changing Our World: True Stories of Women Engineers*. Reston, VA: American Society of Civil Engineers.

Maury, Antonia Caetana de Paiva Pereira

1866 1952

Astronomer

Education: B.A., Vassar College, 1887

Professional Experience: staff member, Harvard College Observatory, 1888–1896; teacher and lecturer, physical science and astronomy, various institutions, 1896–1918; staff member, Harvard College Observatory, 1918–1935; curator, Draper Park Observatory Museum, 1935–1938

Antonia Maury was an astronomer whose research interests were spectra of bright Northern stars and spectroscopic binaries. She was one of the first women to receive a professional appointment at the Harvard College Observatory. She started working at Harvard in 1888 after she graduated with honors from Vassar. In her research, she developed a new, two-dimensional system of stellar

classification that included the width and sharpness of lines. It turned out that the differences in width and sharpness resulted from differences in the size and luminosity of stars. During that time, she also confirmed the observatory director Edward C. Pickering's discovery of a double star and then discovered a second star system. She left the observatory in 1896 due to conflicts with Pickering, who wanted his staff to gather data quickly under another system, while Maury wanted to develop a classification that yielded a wider range of data. Maury lectured and taught at several schools in the interim, but returned to the observatory in 1918 after Pickering retired. Her other significant work was on spectroscopic binaries, including some very complex systems, but she did not work steadily on this area of research. After retiring from Harvard in 1935, she spent three years as curator of the Draper Park Observatory Museum in New York.

Although Maury's contributions were not fully appreciated at Harvard, they had a significant influence on scientists elsewhere. Her early studies are now widely recognized as an essential step in the development of theoretical astrophysics, and she received the Annie J. Cannon Prize of the American Astronomical Society in 1943. Although she worked chiefly as an astronomer, she also was an active ornithologist, a naturalist, and a conservationist who participated in the campaign to save the redwood forests. She was a member of the American Astronomical Society, the Royal Astronomical Society, and the National Audubon Society. Her younger sister was paleontologist **Carlotta Maury**.

Maury, Carlotta Joaquina

1874 1938

Paleontologist

Education: Radcliffe College, 1891–1894; Ph.B., Cornell University, 1896, Ph.D., Cornell University, 1902

Professional Experience: high school teacher, 1900–1901; assistant, paleontology, Columbia University, 1904–1906; paleontologist, Louisiana Geological Survey, 1907–1909; lecturer, geology, Barnard College, 1909–1912; professor, geology and zoology, University of the Cape of Good Hope, 1912–1915; paleontologist, Brazil Survey, 1918–1938

Carlotta Maury was a paleontologist whose research interests were in the recent and Pleistocene eras of New York and the Gulf of Mexico, the Tertiary period of Florida and the West Indies, and stratigraphy of Venezuela. She received degrees from Radcliffe and Cornell, and studied at the Jardin des Plantes in Paris for one year before receiving her doctorate from Cornell University in 1902.

Maury participated in several research expeditions and published numerous reports of her work on Antillean, Venezuelan, and Brazilian stratigraphy and fossil faunas. Many of these reports were sent to the American Museum of Natural History. She was the author of *A Comparison of the Oligocene of Western Europe and the Southern United States* (1902). She was the paleontologist for a geological expedition to Venezuela in 1910 and 1911, organized and conducted the Maury expedition to the Dominican Republic in 1916, was consulting paleontologist and stratigrapher for the Venezuelan division of the Royal Dutch Shell Petroleum Company from 1910 to 1938, and was official paleontologist to Brazil from 1918 to 1938.

Maury was elected a fellow of both the Geological Society of America and the American Geographical Society. She also was a member of the American Association for the Advancement of Science and a corresponding member of the Brazilian Academy of Sciences. Her older sister was astronomer **Antonia Maury**.

McCammon, Helen Mary (Choman)

b. 1933

Geologist, Marine Biologist

Education: B.Sc., University of Manitoba, 1955; M.S., University of Michigan, 1956; Ph.D., geology, Indiana University, 1959

Professional Experience: research technician, stratigraphy, Manitoba Department of Mines and Natural Resources, 1952–1959; lecturer, geography, University of North Dakota, 1961; assistant professor, geology, Department of Earth Science, University of Pittsburgh, 1963–1968, associate professor, 1968; visiting associate professor, geology, Department of Geology, University of Illinois, Chicago, 1968–1970; research associate, geology, Field Museum of Natural History, Chicago, 1969–1972; director of environmental science, Environmental Protection Agency, 1973–1976; senior oceanography and marine scientist, Environmental Research Division, U.S. Department of Energy, 1977–1979, director, 1979–1991, deputy director, Environmental Science Division, 1991–retired

Helen McCammon is a geologist who is also known for her work in marine physiology and ecology. Like many environmental scientists, her research has required broad interdisciplinary knowledge and includes the impact of energy activities in coastal and terrestrial environments ranging from arctic tundra to temperate forest and desert regions, as well as marine physiology and ecology. As deputy director of the Environmental Science Division of the U.S. Department of Energy, her responsibilities included overseeing ecological research and overseeing the division's budget. Her background also includes considerable experience in research

and teaching geology in several universities, plus a stint as a geologist at the Field Museum of Natural History in Chicago. However, her research included studies of living animals as well as terrestrial and marine physical environments, the usual subjects of geologists.

After she completed her dissertation on paleontology for her doctorate in geology, McCammon decided to study how marine organisms live today and began to research living invertebrates, especially brachiopods. These lampshells were common 300 million years ago and can still be found in New Zealand, the Antarctic, and other cold-water regions. Her fieldwork took her to many of these places, but because geology is a male-dominated field, she had problems in obtaining funding and having her papers published. She also faced discrimination at the University of Illinois, Chicago when the department head decided to discontinue her salary in order to hire a man, and asked her to continue teaching as an unsalaried faculty member. Her husband was a faculty member at the university at the time, but her position had been only that of a visiting associate professor. She refused to accept the arrangement and accepted a position at the Field Museum instead. Her own husband was supportive of her research, sharing household duties, involving the children in their sample-collecting and research, and supporting their long-distance relationship when he still worked in Chicago and Helen took a position with the U.S. government in Boston and then Washington, D.C. In 1973, she joined the Environmental Protection Agency, beginning her long career with the federal government as chief scientist and administrator in various departments.

McCammon is a fellow of the American Association for the Advancement of Science and a member of the American Geological Institute, American Society of Zoologists, Oceanic Society, and American Society of Limnology and Oceanography.

McClintock, Barbara

1902–1992

Geneticist

Education: B.S., botany, Cornell University, 1923, M.A., botany, 1925, Ph.D., botany, 1927

Professional Experience: instructor, botany, Cornell University, 1927–1931, research associate, 1934–1936; fellow, National Research Council, 1931–1933; fellow, Guggenheim Foundation, 1933–1934; assistant professor, botany, University of Missouri, 1936–1941; staff member, Carnegie Institution of Washington, Cold Spring Harbor Laboratory, 1942–1967, distinguished member, 1967–1992; Andrew White Professor at Large, Cornell University, 1965–1992

Barbara McClintock received the Nobel Prize in Physiology or Medicine in 1983 for her pioneering work on the mechanism of genetic inheritance. She discovered early on that genes can move from one area on the chromosomes to another, a finding known as “jumping genes” that now helps molecular biologists identify, locate, and study genes. She observed the changes in color patterns in kernels of Indian corn and correlated these changes with changes in the chromosome structure. She received the Nobel Prize for this discovery more than 32 years after publishing her findings. In spite of early recognition for her work, she was relatively unknown in the scientific community for decades until she was awarded the Nobel Prize. Her work was largely outside the mainstream of science at that time, and few were able to comprehend the significance of her research until other scientists’ work on DNA in the 1960s was used to verify her experiment and support her theories.

After she received her doctorate in botany in 1927, McClintock stayed on at Cornell as an instructor for five years, and then worked in research for another six years under fellowships from the National Research Council and the Guggenheim Foundation. Since Cornell was not appointing women to faculty positions, she had to find other sources for income. Research positions were very scarce for women during the Depression, but she accepted an appointment as assistant professor of botany at the University of Missouri for five years. That was the last teaching position she held, as she preferred to focus exclusively on research. Starting in 1942, she worked at the Cold Spring Harbor Laboratory on Long Island, where she maintained a small apartment on the grounds of the laboratory. In 1981, she was awarded a lifetime tax-free annual fellowship of \$60,000 from the MacArthur Foundation, and she continued to work her accustomed schedule of long hours seven days a week in the lab until just shortly before her death.

McClintock was elected a member of the National Academy of Sciences in 1944 and was the first woman president of the Genetics Society of America in 1945. She received the Kimber Genetics Award (1967), the National Medal of Science (1970), the Rosenstiel Award (1978), and the Lasker Award (1981). She was a member of the American Association for the Advancement of Science, the American Academy of Arts and Sciences, the American Philosophical Society, the American Society of Naturalists, and the Royal Society of England. In 2005, the U.S. Postal Service issued a postage stamp featuring McClintock as part of their *American Scientists* series.

Further Resources

Keller, Evelyn Fox. 1983. *A Feeling for the Organism: The Life and Work of Barbara McClintock*. San Francisco, CA: W.H. Freeman.

Fedoroff, Nina V. and David Botstein. 1992. *The Dynamic Genome: Barbara McClintock's Ideas in the Century of Genetics*. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.

The Barbara McClintock Papers, Profiles in Science, National Library of Medicine. <http://profiles.nlm.nih.gov/LL/>.

McCoy, Elizabeth Florence

1903–1978

Soil Microbiologist

Education: B.S., University of Wisconsin, 1925, M.S., 1926, Ph.D., bacteriology, 1929

Professional Experience: postdoctoral fellow, National Research Council, Rothamsted Experimental Station, England, and Botanical Institute, Karlova University, Prague, Czechoslovakia, 1929–1930; assistant to associate professor, agricultural bacteriology, University of Wisconsin, 1930–1943, professor, 1943–1973

Elizabeth McCoy was a microbiologist whose research included anaerobes, serology, freshwater bacteria, water quality and waste disposal, and industrial fermentations. She was notable for her work in soil microbiology and for detecting a high-yielding strain of *penicillium* as part of a World War II-era government project with the Office of Scientific Research and Development. She discovered another antibiotic, oligomycin, which is still used to research and treat fungal diseases in plants and was also under development at that time by the pharmaceutical company Pfizer. McCoy was granted patents for her methods of isolating oligomycin and for processing butyl alcohol. She gained national attention as a female scientist when the *New York Times* reported in 1946, “Wisconsin University Girl Wins Patent on an Industrial Solvent”; at the time, McCoy was hardly a “girl,” as she was a 43-year-old professor of bacteriology.

McCoy was born and raised on a Wisconsin farm, and she developed an early interest in agricultural science and diseases. She received her bachelor’s, master’s, and doctoral degrees in agricultural bacteriology at the University of Wisconsin, where she was then employed as a faculty member for more than 40 years, one of the few women of that time to advance to full professor. Over the years, she conducted research experiments in California, Puerto Rico, England, and Czechoslovakia, and was involved in notable studies related to botulinum food poisoning, vaccine development, and microbial ecology (pollution) of rivers and lakes. She oversaw

bacteriological and water-quality research projects at Trout Lake Station in northern Wisconsin, at nearby Lake Mendota, and at Lake Michigan. She published numerous scientific papers and articles, and authored or co-authored books on *Root-nodule Bacteria and Leguminous Plants* (1932) and *Anaerobic Bacteria and Their Activities in Nature and Disease* (1939).

McCoy was elected a fellow of the American Public Health Association and was a member of the American Association for the Advancement of Science, the American Academy of Microbiologists, the Society for Experimental Biology and Medicine, and the Wisconsin Academy of Sciences, Arts and Letters, for which she served as president. She served as editor of *Biological Abstracts* and of the *Journal of Bacteriology*. She received a posthumous honorary doctorate from the University of Wisconsin, Milwaukee. After her death, her patents, as well as her family farm, were donated to the Wisconsin Alumni Research Foundation.

Further Resources

Fisher, Madeline. 2003. "Discovery Provides Reminder of Bacteriology Prof and WARF Inventor." Wisconsin Alumni Research Foundation. (November 5, 2003). http://www.warf.org/news/news.jsp?news_id=138.

McCracken, (Mary) Isabel

1866 1955

Entomologist

Education: A.B., Stanford University, 1904, A.M., 1905, Ph.D., 1908; University of Paris, 1913–1914

Professional Experience: teacher, public schools, 1890–1900; assistant in physiology and entomology, Stanford University, 1903–1904, instructor, entomology and bionomics, 1904–1909, assistant professor, entomology and zoology, 1909–1918, associate professor, 1918–1930, professor, 1930–1931; research associate, California Academy of Sciences, 1931–1945

Isabel McCracken was an entomologist who conducted research on a variety of topics, including bees, beetles, birds, mosquitoes, and silkworms, and taught in the area of economic entomology. Her career followed the pattern of many women of her generation in that she first taught in the public schools of her native Oakland, California, for more than a decade before entering college. She attended Stanford University and was employed as a staff assistant while working toward her advanced degrees, with studies in physiology, natural history, and entomology.



Entomologist Isabel McCracken. (National Library of Medicine)

She conducted field research and published scientific papers on the genetics of beetles and on birds of the Sierra Nevada mountains. She received her Ph.D. in 1908, at the advanced age of 42. She became an assistant professor of entomology and zoology after receiving her doctorate, and spent the remainder of her career at Stanford, finally advancing to full professor in 1930, just one year before she retired. After her retirement from teaching, McCracken worked as a research associate at the California Academy of Sciences. Her research there concentrated on her long-term interest in birds and their relationship to insects.

In addition to her scientific papers, McCracken co-authored a textbook called *The Animals and Man* (1911). She was elected a fellow of the California Academy of Sciences, and she was a member of the Entomological Society of America.

McFadden, Lucy-Ann Adams

b. 1952

Astronomer, Geophysicist

Education: B.A., natural sciences, Hampshire College, Massachusetts, 1974; M.S., earth and planetary science, Massachusetts Institute of Technology, 1977; Ph.D., geology and geophysics, University of Hawaii, 1983

Professional Experience: research associate, geography, University of Maryland and Goddard Space Flight Center, National Aeronautics and Space Administration (NASA), 1983–1984, research associate, astronomy, University of Maryland, 1984–1986, assistant research scientist, astronomy, 1986–1987; assistant research physicist, California Space Institute, University of California, San Diego, 1987–1991, associate research physicist, 1991–1995; associate research scientist, graduate faculty, astronomy, University of Maryland, 1996–2007, research professor, 2007–

Concurrent Positions: National Science Foundation visiting professor, University of Maryland, 1992–1995; Near-Earth Asteroid Rendezvous (NEAR) Mission Science Team Multispectral Imager/Near-Infrared Spectrometer, 1994–2000; visiting scientist, Space Telescope Science Institute, 1995; faculty director, College Park Scholars, Science, Discovery & the Universe program, 1997–2001; Deep Impact Discovery Mission Co-Investigator, Education/Outreach Manager, NASA, 1999–2006; Dawn Discovery Mission, 2002–2015; Deep Impact Extended Mission, 2007–2011

Lucy-Ann McFadden is a planetary scientist who has specialized in searching for Earth-approaching asteroids and dead comets. She has estimated that between 1,500 and 2,000 asteroids and dead comets roam space near the Earth. Most asteroids and comets pass Earth at high speed millions of miles away, but those that come closer provide astronomers with insight into the solar system's past. The small bodies in the inner solar system contain primarily rock and metal, while those in the outer solar system contain ices and dark, carbon-based compounds. The difference in composition among various types indicates how material was spread through the solar system while it was forming, and by bouncing radar beams off their surfaces, astronomers can determine the sizes, shapes, and compositions of the objects. McFadden's research involves determining the surface composition of asteroids to understand their nature, source, and evolution. She uses the Hubble Space Telescope to study the relationship between asteroids and comets based on the composition of solid components and the reflectance properties of meteorites. She has published numerous papers on the characteristics of the objects that she has studied and also participated in the observations of the Shoemaker-Levy comet (named for Gene and **Carolyn Shoemaker**, who first identified the comet that impacted Jupiter).

In addition to her position as a faculty research scientist at the University of Maryland, McFadden has been a principal investigator and educational and outreach director of several NASA missions that have included observations of Mars, the moon, and other planets. Through her work at NASA, in her local community, and through the Internet, she has been heavily involved in promoting educational programs that inspire students to pursue careers in the sciences. She is also the co-editor of the *Encyclopedia of the Solar System* (2006).

McFadden has received numerous awards and honors from NASA and other institutions. She is a member of the American Association for the Advancement of Science, American Astronomical Society, American Geophysical Union, and Meteoritical Society.

Further Resources

University of Maryland. Faculty website. <http://www.astro.umd.edu/~mcfadden/>.

McNutt, Marcia Kemper

b. 1952

Marine Geophysicist

Education: B.A., physics, Colorado College, 1973; Ph.D., earth science, Scripps Institution of Oceanography, University of California, San Diego, 1978

Professional Experience: postdoctoral research associate, Scripps Institution of Oceanography, 1978; visiting assistant professor, University of Minnesota, 1978–1979; geophysicist, tectonophysics, Office of Earthquake Studies, U.S. Geological Survey (USGS), 1979–1982; assistant professor, geophysics, Massachusetts Institute of Technology (MIT), 1982–1986, associate professor, 1986–1988, professor, 1989–1998; president and chief executive officer, Monterey Bay Aquarium Research Institute, 1997–2009; director, USGS, 2009–

Concurrent Positions: secretary, John Muir Geophysical Society, 1979–1983; associate editor, *Journal of Geophysical Research*, 1980–1983; associate director, MIT SeaGrant College, 1993–1995; director, Joint Program in Oceanography and Applied Ocean Science and Engineering, MIT and Woods Hole Oceanographic Institution, 1995–1997; affiliated professor, geophysics, Stanford University, 1998–; affiliated professor, earth sciences, University of California, Santa Cruz, 1998–

Marcia McNutt is renowned for her research on plate tectonics using a variety of techniques, including the Geosat global-positioning satellite. She is particularly known for her work on mapping the ocean floor and measuring the depth of the ocean. Her research includes studies of long-term rheology of the Earth's crust and upper mantle using gravity and topography data, isotasy, paleomagnetism of seamounts, and thermal modeling of the lithosphere. Plate tectonics, a science that developed around 1965 to 1970, is the theory of global tectonics in which the lithosphere is divided into a number of crustal plates, each of which moves on the plastic asthenosphere more or less independently to collide with, slide under, or move past adjacent plates. The study of plate tectonics seeks to explain how the continents were formed and to predict how the plates will move into new patterns. Although geologists have mapped much of the land portion of the Earth, data on the oceans are still being revealed and much of it has remained classified by the U.S. government for strategic reasons. The data that have been released can indicate new locations for fishing or for oil drilling as well as predicting the future activity of underwater volcanoes.

McNutt has worked particularly on mapping areas of the southern oceans, which had remained uncharted because they are far from shipping lanes and not of strategic importance from a military standpoint. The standard method has been

to use echo sounders by deploying entire arrays of acoustic transceivers on the hulls of ships to measure the ocean depth in a swath several kilometers wide. McNutt has improved this research by using highly sensitive radar altimeters in Earth orbit to sense minute changes in sea level caused by the gravitational attraction of topography on the seafloor; the radar altimeters measure the water density by hitting the water/rock interface on the ocean floor. The measurements obtained by the echo sounders and by the radar altimeters provide similar readings, but the orbiting altimeters provide a much higher resolution than the echo sounders. In addition to her faculty appointments, in 1997, McNutt became Director of the Monterey Bay Aquarium Research Institute (MBARI) in Moss Landing, California, a position she held for more than 10 years. In 2009, she was chosen by President Obama as the new head of USGS and science advisor to the U.S. Secretary of the Interior.

McNutt was elected to the National Academy of Sciences in 2005. She has been a member of the National Aeronautical and Space Administration (NASA) Science Steering Group Geopotential Research Mission, the Committee on Geodesy of the National Research Council, and the Geodynamics Committee, and was chair of the President's Panel on Ocean Exploration under President Clinton. She is a fellow of the American Geophysical Union (president, 2000–2002), Geological Society of America, American Association for the Advancement of Science, American Academy of Arts and Sciences, and International Association of Geodesy. McNutt has received numerous awards and honors for her research, including the James B. MacElwane Medal of the American Geophysical Union (1988), Scientist of the Year award from the ARCS Foundation (2003), and Maurice Ewing Medal from the Society of Exploration Geophysicists (2007).

Further Resources

U.S. Geological Survey. "Marcia McNutt, Director, U.S. Geological Survey." <http://www.usgs.gov/aboutusgs/organized/bios/mcnutt.asp>.

McSherry, Diana Hartridge

b. 1945

Medical Physicist, Computer Scientist

Education: B.A., physics, Harvard University, 1965; M.A., Rice University, 1967, Ph.D., nuclear physics, 1969

Professional Experience: fellow, nuclear physics, Rice University, 1969; research physicist in ultrasonics, Digicon, Inc., 1969–1974, executive vice president of

medical ultrasound, 1974–1977; president, cardiology analysis systems, Digisonics, Inc., 1977–1982; vice president, Digicon, Inc., 1980–1987; chief operating officer, Cogniseis Development, Inc., 1987–1995, president, 1995–; president, Digisonics

Concurrent Positions: chair, Information Products Systems, Houston, 1982–1986

Diana McSherry is a research biophysicist known for her development of computer-based cardiology analysis systems and has worked in the specific areas of echocardiology, ventriculography, and hemodynamics. Echocardiology uses reflected ultrasonic waves to examine the structure and functioning of the heart; ventriculography involves examining the ventricles of the heart, which are the lower chambers on each side of the heart that receive blood from the atria and in turn force it into the arteries; and hemodynamics is the branch of physiology dealing with the forces involved in the circulation of the blood. The system she developed uses ultrasonic waves and computer processing to produce images of the heart and circulation system, and it was a major breakthrough in the 1970s, when scientists were just beginning to develop the software for medical applications. Her product permits physicians to view the inside of a patient's body without making an incision; the ultrasound is reflected from the heart, producing an image that is refined after being fed into a computer.

After receiving her doctorate from Rice University, McSherry was a fellow in nuclear physics there for one year and then spent the rest of her career working in corporations. She started as a research physicist in ultrasonics at Digicon, Inc., and became executive vice president of medical ultrasound and then president of cardiology analytical systems when the company was acquired by Digisonics, Inc. She is currently president and manager of Digisonics, which creates ultrasound equipment and systems for use in cardiology, radiation, and OB/GYN applications. She also served on the board of directors as chair for Information Products Systems, Houston.

McSherry is a member of the Institute of Electrical and Electronics Engineers, American Institute of Ultrasound in Medicine, American Physical Society, and American Heart Association.

McWhinnie, Mary Alice

1922 1980

Biologist

Education: B.S., DePaul University, 1944, M.S., biology, 1946; Ph.D., biology, Northwestern University, 1952

Professional Experience: assistant, biological sciences, DePaul University, 1944–1950, instructor, 1950–1952, assistant to associate professor, biology, 1952–1960, professor, 1960–1980

Mary McWhinnie was one of the first two women scientists to winter in Antarctica to study krill. Her research involved crustacean metabolism, with special reference to carbohydrates during the molt cycle, and her findings highlighted the importance of krill to the ocean food chain. As a child growing up in Illinois, she developed an interest in nature and, especially, fishing, and went on to study biology at DePaul University. She worked as an assistant in biological sciences at the university while also completing her master's degree, and went on to receive her Ph.D. from Northwestern University.

She spent her entire teaching career at DePaul University, advancing through the ranks from instructor to professor. It was while studying crayfish in Chicago that she became interested in comparing them to their cold-water cousins, krill. She prepared a proposal for the National Science Foundation (NSF) and, in 1962, embarked on a two-month research cruise as the first American woman scientist assigned to the U.S. Antarctic Research program. She returned again in 1972, this time as the ship's chief scientist, and in 1974, she and her female research assistant were the first women to spend the winter at the McMurdo research station on Antarctica.

Over the course of her career, McWhinnie made 11 trips to Antarctica to study krill and became the worldwide expert on krill as an ocean food source. In the late 1970s, she became an ecological spokesperson advocating for the protection of krill against overfishing. McWhinnie fell ill while preparing for another trip to Antarctica in the winter of 1979–1980 and died at the age of 57 of undiagnosed cancer of the lungs and brain.

McWhinnie received numerous NSF grants to carry on her polar biology research, as well as other funding, such as an assistantship at Woods Hole Marine Biological Laboratory in 1952, summers as a faculty fellow of the American Physiological Society in 1957, and fellow of the Lalor Foundation in 1958. She was a member of the Panel on Biological and Medical Sciences of the National Academy of Science, and the National Science Foundation Committee on Polar Research. She was elected a fellow of the American Physiological Society and was a member of the American Association for the Advancement of Science and the Biophysical Society.

Further Resources

Land, Barbara. 1981. *The New Explorers: Women in Antarctica*. New York: Dodd, Mead.
 Chipman, Elizabeth. 1986. *Women on the Ice: A History of Women in the Far South*. Carlton, Vic.: Melbourne University Press.

Mead, Margaret

1901–1978

Anthropologist

Education: B.A., Barnard College, 1923; M.A., psychology, Columbia University, 1924, Ph.D., anthropology, 1929

Professional Experience: assistant to associate curator, ethnology, American Museum of Natural History, 1926–1964, curator, 1964–1969; instructor and adjunct professor, anthropology, Columbia University, 1947–1978

Concurrent Positions: instructor, Vassar College, New York University, Fordham University, and others; director, Columbia University Research in Contemporary Cultures, 1948–1950



Anthropologist Margaret Mead in Samoa, in a photo sent to colleague **Ruth Benedict**, 1926. (Library of Congress)

Margaret Mead was perhaps the foremost anthropologist of the twentieth century. Through such bestselling books as *Coming of Age in Samoa* (1928), *Sex and Temperament in Three Primitive Societies* (1935), and *Male and Female* (1949), she changed anthropology from an esoteric discipline to a subject that was fascinating to the public at large. Her expeditions to Samoa, New Guinea, and Bali, and her work with Native American tribes, provided material for more than 1,500 books, articles, films, and occasional pieces. She was the first anthropologist to compare childrearing practices and roles of women in various cultures, topics that had not been of interest to male anthropologists. She was a founder of a new school of anthropology that examines the ways a culture shapes an individual's personality. Along with her third husband, Gregory Bateson, she pioneered the use of

photography and eventually film and video to document vanishing cultures, and thus her work was spread to the general public in new ways.

Mead's father was a faculty member at the University of Pennsylvania, her mother a sociologist, and her paternal grandmother a pioneer child psychologist. Mead received her master's degree in psychology from Columbia in 1924 and then spent six months studying adolescents in Samoa. She came to the controversial conclusion, explained in *Coming of Age in Samoa*, that people were a product of their environment more than heredity. In later years, she conceded that she was too inexperienced as a field investigator at the time she made the study, but she never revised the book or returned to Samoa. She went on to conduct fieldwork on the Manus tribe of the Admiralty Islands and, with her second husband, Reo Fortune, visited three native American tribes—the Arapesh, the Mundugumor, and the Tcambuli—to study the social conditioning of the two sexes. Later, with Bateson, she engaged in fieldwork in Bali and New Guinea. Her book *And Keep Your Powder Dry* (1942) studied American character against the background of seven other cultures.

In addition to her faculty appointments, Mead was affiliated with American Museum of Natural History for much of her career and established a Hall of Peoples of the Pacific there. She was the first female president of the Society for Applied Anthropology in 1949, and also served as president of the American Anthropological Association in 1960 and the American Association for the Advancement of Science in 1975. She was elected a member of the National Academy of Sciences in 1975 and the American Philosophical Society in 1977. She also was a member of the American Academy of Arts and Sciences. Her autobiography is *Blackberry Winter: My Earlier Years* (1972), and there are numerous biographies, including a family history by her daughter, cultural anthropologist **Mary Catherine Bateson**.

Further Resources

Banner, Lois W. 2003. *Intertwined Lives: Margaret Mead, Ruth Benedict, and Their Circle*. New York: Random House.

Bateson, Mary Catherine. 1984. *With a Daughter's Eye: A Memoir of Margaret Mead and Gregory Bateson*. New York: W. Morrow.

Medicine, Beatrice A.

1924 2005

Anthropologist

Education: B.S., education, art, and history, South Dakota State University, Brookings, 1945; M.A., sociology and anthropology, Michigan State University, 1953; Ph.D., cultural anthropology, University of Wisconsin, Madison, 1983

Professional Experience: lecturer, sociology and anthropology, University of Montana, Missoula, 1967–1968; director, American Indian Research, Oral History Project, and assistant professor, anthropology, University of South Dakota, Vermillion, 1968–1969; assistant professor, anthropology, San Francisco State University, 1969–1970, associate professor, 1970–1971; predoctoral lecturer, anthropology, University of Washington, Seattle, 1971–1973; visiting professor, anthropology, Native American Studies, Dartmouth College, 1973–1974; visiting professor, anthropology, Colorado College, 1974–1975; visiting associate professor, anthropology, Stanford University, 1975–1976; associate professor, anthropology, and coordinator, Interdisciplinary Program in Native American Studies, California State University, Northridge, 1982–1985; professor, anthropology, and director, Native Centre, University of Calgary, Canada, 1985–1988

Concurrent Positions: assistant professor, Teacher Corps, University of Nebraska, Omaha, summer 1969; fellow, Center for the History of American Indians, Newberry Library, Chicago, 1972–1973; visiting professor, educational anthropology, University of New Brunswick, Canada, summer 1976; visiting professor, Education Policy Sciences, University of Wisconsin, Madison, summer 1979; visiting professor, Graduate School of Public Affairs, University of Washington, Seattle, spring 1981; lecturer, Standing Rock College, North Dakota, 1989; visiting professor, anthropology, Humboldt State University, California, 1991; visiting professor, Colorado College, 1991; visiting professor, Saskatchewan Indian Fed. College, Canada, 1991; visiting distinguished professor, women's studies, University of Toronto, 1992; research coordinator, Women's Perspectives, Royal Commission on Aboriginal Peoples, Ottawa, Ontario, Canada, 1993–1994; visiting professor, rural sociology, South Dakota State University, Brookings, 1993; visiting scholar, Museum of Anthropology, University of British Columbia, Vancouver, 1995; adjunct professor, Department of Educational Foundations, University of Alberta, Edmonton, 1995–2005; Buckman Professor, Department of Human Ecology, University of Minnesota, Twin Cities, 1996; Stanley Knowles Distinguished Professor, Brandon University, Manitoba, Canada, 1998, visiting professor, 1999–2005

Beatrice Medicine was a recognized expert on the study of tribal traditions among the Dakota Indians. She was one of the few Native American women to earn an advanced degree in anthropology, and she worked to dispel anthropological myths that have tended to oversimplify and homogenize Native American cultures. In her writing and teaching, she established a more realistic picture of the plurality and diversity of Native American life from the real and complex Native American perspectives. Her research centered on the changing Native American family and on women's roles, real and perceived, past and present. Much erroneous information

exists because the first narratives and histories were written by white men who were the product of a patriarchal society, and they largely ignored or incorrectly reported the role of women in Native American society. She had an already long career as a visiting professor and fellow at numerous colleges and universities before attending the University of Wisconsin at Madison as an Advanced Opportunity Fellow to complete her doctorate in anthropology in 1983. She went on to direct Native American studies programs at several universities, including at California State University, Northridge, and the University of Calgary, Alberta, Canada. Even after her formal retirement in 1988, she continued to be a visiting or adjunct professor at several institutions in both the United States and Canada.

Although she spent a career in academia, Medicine maintained strong ties to her reservation home. She was born and raised on the Standing Rock Sioux Reservation in northern South Dakota, and her family stressed maintaining tribal traditional cultural identity. In addition to her research on her own people, Medicine was involved in work with the aboriginal peoples of New Zealand, Australia, and Canada. She was extensively involved in the field of mental health, focusing on issues such as alcohol and drug abuse among Native Americans. The title of her doctoral thesis was “An Ethnography of Drinking and Sobriety among the Lakota Sioux.” She was an advocate for Indian leadership and helped establish a network of Indian social service centers in urban areas. In her role as head of the Women’s Branch of Canada’s Royal Commission on Aboriginal Peoples, she helped draft legislation protecting the legal rights of native families.

Medicine published more than 60 articles and chapters in books, including *Native American Women: A Perspective* (1978) and *The Hidden Half: Studies of Plains Indians Women* (1983). A collection of her writings, entitled *Learning to Be an Anthropologist and Remaining “Native,”* was published in 2001. She was a member of the American Anthropological Association and Society for Applied Anthropology.

Further Resources

Medicine, Beatrice and Sue-Ellen Jacobs, eds. 2001. *Learning to Be an Anthropologist and Remaining “Native”: Selected Writings*. Urbana: University of Illinois Press.

Meinel, Marjorie Pettit

1922–2008

Astronomer

Education: B.A., Pomona College, 1943; M.A., astronomy, Claremont College, 1944

Professional Experience: researcher and associate editor, rocket programs, California Institute of Technology, 1944–1945; research associate, solar energy, University of Arizona, 1974–1984; visiting scientist, optics, Jet Propulsion Laboratory, California Institute of Technology, 1984–2000

Concurrent Positions: consultant, Office of Technological Assessment, U.S. Congress, 1974–1980; consultant, Arizona Solar Energy Research Commission, 1975–1981

Marjorie Meinel was recognized for her work on solar energy applications, upper atmospheric phenomena, volcanic eruptions, solar and variable stars, and astronomical optics. As a graduate teaching assistant during World War II, she taught navigation to Army airmen. After receiving her master's degree from Claremont College, she obtained employment on secret military rocket programs at the California Institute of Technology. Throughout her career, she conducted collaborative research with her husband, astronomer Aden Meinel, on solar optics, solar energy, volcanic eruptions, and cosmic radiation. They co-authored several papers and books and, in their later post-retirement years, the couple continued to expand their diverse interests into topics such as paleoanthropology and global warming, pursuing their research and giving public lectures.

Both of Meinel's parents were pioneering astronomers; her father, Edison Pettit, was one of the founding astronomers at Mt. Wilson Observatory in Los Angeles, and her mother, Hanna Steele Pettit, was one of the first women to receive a doctorate in astronomy from the University of Chicago. Marjorie met Aden Meinel when they both enrolled in a program for gifted high school students at Pasadena Junior College. Aden Meinel became the first Director of the Kitt Peak National Observatory (1958–1960) and was the founder and first Director of the Optical Sciences Center at the University of Arizona. Marjorie took time off from her career to raise seven children, but she remained professionally active in collaboration with and support of Aden's research. Once her children were grown, she spent 10 years as a research associate in solar energy at the University of Arizona and was active in the 1970s as a member of state and national solar energy committees. In 1984, the couple returned to California as Distinguished Visiting Scientists at the Jet Propulsion Laboratory, where they researched solar optics and helped launch the Hubble Space Telescope.

Among Meinel's numerous awards and acknowledgements, she was named one of five outstanding "Women in Physics" by the American Physical Society (1980) and received the Goddard Award (1984), the George van Biesbroeck Award for Services in Astronomy (1990), the National Aeronautics and Space Administration (NASA) Exceptional Scientific Achievement Medal (1993), and the Kingslake Medal of the Optical Society of America (1994 and 2001). The Meinels also

received many awards for their joint work, including a Gold Medal Award of the Society of Photographic Instrumentation Engineers (SPIE) (1997). She was a member of SPIE and of the New York Academy of Sciences and the Society of Photo-Optical Instrumentation Engineers.

Further Resources

LaFee, Scott. "Astronomers Link Human Evolution, Cosmic Radiation." <http://www.signonsandiego.com/news/science/20060607-9999-lz1c07meinel.html>.

Mendenhall, Dorothy Reed

1874 1964

Research Physician

Education: B.L., Smith College, 1895; student, chemistry and physics, Massachusetts Institute of Technology; M.D., Johns Hopkins University, 1900

Professional Experience: fellow, Johns Hopkins University, 1901–1902; resident physician, Babies Hospital, New York, 1903–1906; lecturer, home economics, University of Wisconsin, 1914–1936

Concurrent Positions: medical officer, United States Children's Bureau, 1917–1936

Dorothy Reed Mendenhall was recognized first for her early work on Hodgkin's disease and later for her pioneering efforts in obstetrics. In 1900, she was one of the first women to receive a medical degree at Johns Hopkins after the school lifted its ban on admitting women students. More than 50 years later, she would establish a scholarship fund at Johns Hopkins for female medical students. While working as an intern and fellow in pathology and bacteriology at Johns Hopkins, she earned an international reputation for her recognition of the Reed (or Reed-Sternberg) cell, named in her honor, as the distinctive characteristic of Hodgkin's disease. Prior to her work, Hodgkin's disease was believed to be a form of tuberculosis. Since there were few opportunities for women to advance at Johns Hopkins, she moved to New York, where in 1903 she was appointed the first resident physician at Babies Hospital. After losing her own first child at birth, she changed her research interests to improving obstetrics and infant mortality in the United States.

In 1906, she moved to Madison, Wisconsin, where her husband was a faculty member in physics. After an interval of several years to care for her growing family, she became a lecturer in home economics at the University of Wisconsin and

began researching infant mortality, nutrition, and public health. After conducting a campaign of lectures and pamphlets, she organized Wisconsin's first infant welfare clinic in 1915. In 1917, she served as a medical officer for the U.S. Children's Bureau while her husband was on war duty in Washington, D.C. She continued her affiliation with the Children's Bureau until 1936 while maintaining her position at the University of Wisconsin. She studied European countries with low infant mortality rates and used the information to produce numerous bulletins on nutrition and childcare for the university, the Wisconsin State Board of Health, and the U.S. Department of Agriculture. She advocated the use of midwives for healthy pregnancies and specialized training in obstetrics for physicians. Her work also led to the creation of height and weight standards to improve infant and child nutrition and health. She focused not only on the role of doctors, however, also reaching out to women and prospective mothers with correspondence courses on nutrition and hygiene.

Further Resources

National Institutes of Health. "Dr. Dorothy Reed Mendenhall." Changing the Face of Medicine: Celebrating America's Women Physicians. National Library of Medicine, National Institutes of Health. http://www.nlm.nih.gov/changingthefaceofmedicine/physicians/biography_221.html.

Menken, Jane Ava (Golubitsky)

b. 1939

Demographer, Sociologist

Education: A.B., mathematics, University of Pennsylvania, 1960; M.S., biostatistics, School of Public Health, Harvard University, 1962; Ph.D., sociology and demography, Princeton University, 1975

Professional Experience: assistant, biostatistics, School of Public Health, Harvard University, 1962–1964; mathematical statistician, National Institute of Mental Health, 1964–1966; research associate, biostatistics, School of Public Health and Administrative Medicine, Columbia University, 1966–1969; research staff, Office of Population Research, Princeton University, 1969–1971, research demographer, 1975–1980, assistant to associate director, 1978–1987; associate professor, sociology, Princeton University, 1977–1980, professor, sociology and public affairs, 1980–1987, visiting professor, public and international affairs, 1987–1988; professor, social sciences, and research associate, Population Studies

Center, University of Pennsylvania, 1987–2001, director, 1989–1995; professor, sociology, University of Colorado, Boulder, 1997–, and director, Institute of Behavioral Science, 2001–

Concurrent Positions: fellow, Center for Advanced Study in the Behavioral Sciences, Stanford University, 1995–1996; honorary professor, School of Public Health, University of the Witwatersrand, Johannesburg, South Africa, 2006–

Jane Menken is recognized as one of the top demographers in the United States. Demography is the science of vital and social statistics, such as birth, death, diseases, and marriage. It differs from statistics, which is the science that deals with numerical facts or data, in that demography is centered on the populations—the people—and the interpretation and forecasting of trends. Menken's work has often involved controversial social issues, such as the effects of government policy on fertility, breastfeeding rates, and birth control and abortion access. In particular, her work has focused on women's and children's health and on the study of aging. In addition to her numerous scholarly articles and papers, she is the co-author of the book *Mathematical Models of Conception and Birth* (1973), and co-editor of *Natural Fertility* (1979), *Teenage Sexuality, Pregnancy, and Childbearing* (1981), *World Population and U.S. Policy: The Choices Ahead* (1986), and, most recently, *Aging in Sub-Saharan Africa* (2006). She is a founding member of the editorial board of two journals, *Demographic Research* and *Southern African Journal of Demography*.

Menken worked for the federal government for a short time as a statistician for the National Institute of Mental Health, but has primarily been employed by major universities with distinguished reputations in demography. She has been a visiting scholar, invited lecturer, and conference participant at institutions around the world, and has served on numerous panels and commissions including, but not limited to, as a member of the population advisory committee for the Rockefeller Foundation (1981–1993), member of the committee on AIDS research of the National Academy of Sciences (1987–1994), chair of Family Health International's project on *The Impact of Family Planning Programs on Women's Lives* (1994–1998), and member of the World Health Organization Study on Global Aging and World Health (2004–2006). She has also served in numerous advisory roles for National Research Council and National Institutes of Health (NIH) studies on population and fertility.

Menken is an elected member of the National Academy of Sciences (1989) and the Institute of Medicine (1995). She is a former Guggenheim fellow (1992–1993), a fellow of the American Association for the Advancement of Science, and a member of the American Academy of Arts and Sciences, Population Association of America (president, 1985), American Public Health Association,

Sociological Research Association (president, 1995–1996), American Sociological Association, American Statistical Association, Society for the Study of Social Biology, and International Union for the Scientific Study of Population.

Further Resources

University of Colorado. Faculty website. <http://www.colorado.edu/ibs/PP/menken/>.

Michel, Helen (Vaughn)

b. 1932

Nuclear Chemist

Education: B.S., chemistry, University of California, Berkeley, 1955; student, Indiana University, 1955–1956

Professional Experience: chemist, University of California, Berkeley, Radiation Laboratory (later Lawrence Radiation Laboratory), 1956–1990

Helen Michel is a nuclear chemist who achieved great success and worldwide recognition for her expertise in operating the complex electronic instruments in the Lawrence Radiation Laboratory in Berkeley, California. Her analyses led to many important scientific discoveries in the fields of nuclear science, geochemistry, plant biology, and archaeometry, the dating of archaeological specimens through specific techniques such as radiocarbon dating. One study of the mid-1970s that attracted a vast amount of publicity involved her group's role in determining the authenticity of an artifact called the Plate of Brass. Historical evidence indicated it had been left by English explorer Sir Walter Drake in the sixteenth century when he landed on the coast of what is now California. The plate had been discovered in 1936 in San Francisco, and was kept at Berkeley. After examining samples of the metal as well as the plate itself by x-ray fluorescence, atomic absorption, and emission spectroscopy, Michel determined that the Plate of Brass was not authentic and that it had probably been made in the last half of the nineteenth century or the early part of the twentieth. Similar studies conducted at Oxford University verified her conclusions. She was also involved in another news story of the 1980s when her expertise in chemical soil analysis was crucial in a long-term project that substantiated the theory that an asteroid impact resulted in the extinction of the dinosaurs some 65 billion years ago. Michel's contributions to the work that proved the asteroid theory are described in Luis Alvarez's book, *Adventures of a Physicist* (1987), and Walter Alvarez's *T-Rex and the Crater of Doom* (1997), among other reports.

Michel decided on a career in chemistry while still in elementary school, but by the time she completed her college education in the 1950s, it was difficult for a woman to obtain any job, much less in the sciences. She secured a part-time job at the Radiation Laboratory in Berkeley in the Division of Nuclear Chemistry while she was still an undergraduate. She spent a year in graduate work at Indiana University before returning to Berkeley for a full-time position as a chemist. Even without an advanced degree, she earned the respect of her colleagues and was always included as a co-author on all of the papers describing research in which she participated.

In the 1960s, she and her husband expanded their scientific interests to the hobby of breeding orchids. They established a business as part of the Orchid Ranch in Livermore, California, and after retiring from Lawrence Laboratory in 1990, Helen took over much of the daily supervision of the business.

Further Resources

Rogers, Phila W. 1979. "Investigating a Mass Extinction Occurring 65 Million Years Ago." <http://www.lbl.gov/Science-Articles/Archive/fingerprinting-past.html>.

Micheli-Tzanakou, Evangelia

b. 1942

Neurophysicist, Biomedical Engineer, Biophysicist

Education: B.S., University of Athens, 1968; M.S., Syracuse University, 1974, Ph.D., physics, 1977

Professional Experience: fellow, biophysics, Syracuse University, 1977–1980, consultant, 1980–1981; assistant to associate professor, biomedical engineering, Rutgers University, 1981–1990, professor and department chair, 1990–2000, professor and director, Computational Intelligence Laboratories, Department of Biomedical Engineering, 2000–

Concurrent Positions: consultant, Eye Defect and Engineering Research Foundation, 1978–1980; adjunct instructor, University of Medicine and Dentistry of New Jersey

Evangelia Micheli-Tzanakou is a physicist who does extensive research on brain function, including pattern recognition; digital signal processing of biological signals; neural networks, data compression, and image reconstruction; hearing aids; and neural network modeling of the brain. She is renowned for her research in using optimization techniques to understand to problems of brain functions and dysfunctions, and she has pursued a multiphase quest in order to gain this

understanding. Some of the methods she developed are used in cardiology to predict the prognosis of heart-attack patients, and she has compared people who age normally with patients who have Alzheimer's and Parkinson's diseases. She has developed a set of algorithms for modeling the visual system and applied this technique to other functions of the nervous system and to research other brain functions, such as pattern recognition. In 1994, her research indicated that people with advanced educational and occupational attainment are able to cope longer before the onset of Alzheimer's, a finding that has proved controversial.

Biomedical engineering, or bioengineering, is a relatively new discipline that developed in the 1960s and involves the application of engineering principles and techniques to problems of medicine and biology. In many institutions, it is an interdisciplinary effort on the part of physicians, biophysicists, electrical engineers, and computer scientists. Some researchers have expertise in several or all of these disciplines. In Micheli-Tzanakou's work, information processing by the visual system is examined by computer-controlled techniques, and recordings are done both in animals and in humans. In 1996, she and her co-author described designing a neuromime circuit to be used for modeling nerve networks from living organisms by using very large-scale integration (VLSI) technology.

Micheli-Tzanakou is a founding fellow of the American Institute for Medical and Biological Engineering. She is also a fellow of the Institute of Electrical and Electronics Engineers (IEEE) and has served on numerous boards and committees for that group. She is a member of the Society for Neuroscience, Association for Research in Ophthalmology, and Biophysical Society.

Further Resources

Rutgers University. Faculty website. <http://cil.rutgers.edu/tzanakou/BriefCV.htm>.

Mielczarek, Eugenie Vorburger

b. 1931

Solid-state Physicist, Biophysicist

Education: B.S., Queens College, 1953; M.S., Catholic University, 1957, Ph.D., physics, 1963

Professional Experience: physicist, U.S. National Bureau of Standards, 1953–1957; research assistant, Catholic University, 1957–1959, research associate, 1959–1962, assistant research professor, 1962–1965; professor, physics, George Mason University, 1965–, emerita

Concurrent Positions: visiting scientist, National Institutes of Health, 1965–

Eugenie Mielczarek is known for her work in biophysics, which is the conjunction between biology and physics. Her research includes solid-state low-temperature physics, semiconductors, Mossbauer spectroscopy of metal and biological compounds, biophysics, and Fermi surfaces of metals. Working with Mossbauer spectroscopy, she is applying the techniques of nuclear physics to biological materials in order to probe the molecular environment around iron atoms. She explains that our bodies contain iron. Persons who have sickle-cell anemia or Cooley's anemia suffer from damaged kidneys and spleens. The red blood cells break down more rapidly in these persons than in healthy individuals, and this breakdown dumps iron into those major organs. Iron chelators, or iron-grabbing compounds, are needed to clean up the excess iron, and we need to understand the atomic environment of iron in iron-chelating compounds in order to prevent the damage caused by the iron buildup.

Her early research was in solid-state metals physics, but she has moved into studies of metal in biological environments. Solid-state physicists increasingly are studying more complex biological systems, looking at hemoglobin, cell membranes, and brain waves, work that has application to living systems. For example, she has also studied the dangerously high noise levels from music played in aerobic exercise classes, making recommendations for how to protect the hearing of both instructors and participants in such situations.

She initially found it difficult to find employment as a female physicist, but finally obtained a position at the U.S. National Bureau of Standards, where she worked while completing her graduate degrees. Later, she was the founding chair of the physics department at George Mason University, a department that still maintains a higher-than-average number of female professors. Mielczarek is a member of the American Physical Society, Biophysical Society, American Association of Physics Teachers, and Association of Women in Science. She was co-editor (with Robert S. Knox) of *Biological Physics* and co-author (with Sharon Bertsch McGrayne) of *Iron, Life's Universal Element: Why People Need Iron and Animals Make Magnets* (2000).

Miller, Elizabeth Cavert

1920 1987

Biochemist

Education: B.S., biochemistry, University of Minnesota, 1941; M.S., biochemistry, University of Wisconsin, 1943, Ph.D., biochemistry, 1945

Professional Experience: postdoctoral fellow, McArdle Laboratory for Cancer Research, University of Wisconsin, 1945–1947, instructor, department of oncology, 1947–1949, assistant to associate professor, 1949–1969, professor, 1969–1987

Concurrent Positions: associate director, McArdle Laboratory for Cancer Research, University of Wisconsin, 1973–1987; senior research professor and emeritus professor, oncology, Wisconsin Alumni Research Foundation, 1980–1987

Elizabeth C. Miller was a biochemist recognized for her research on cancer and chemical carcinogens. She spent her entire career at the University of Wisconsin, where she collaborated with her husband, James A. Miller. The Millers were the first researchers to discover that an outside chemical could cause cancer in rats. They went on to research how carcinogens bind to DNA and, in the 1960s, worked on growing tumors in live tissue to understand how cancers spread. Their path-breaking research provided insight into later studies and public awareness about potential cancer-causing toxins in the environment such as pollution, industrial chemicals, food additives, and drugs. Together, the Millers published more than 300 papers on chemical carcinogens.

Elizabeth Miller began her graduate research with a scholarship for joint work in biochemistry and home economics. After she received her doctorate at Wisconsin, she held a postdoctoral fellowship and then joined the faculty in 1947 as an instructor in oncology. She advanced through the tenure ranks, becoming a full professor in 1969. At the University of Wisconsin, she also served as associate director of the McArdle Laboratory for Cancer Research from 1973 until her retirement in 1987. She was the editor of *Cancer Research* (1954–1964) and president of the American Association for Cancer Research (1976 and 1978). Between 1978 and 1980, she served on President Carter’s Panel of the National Cancer Institute.

Both Elizabeth Miller and James Miller were elected to the National Academy of Sciences in 1978. They received numerous awards and honors for their work, including the National Award in Basic Science of the American Cancer Society (1977), the first Founder’s Award from the Chemical Industry Institute of Toxicology (1978), and a Mott Award from General Motors Cancer Research Foundation (1980). Elizabeth Miller was a member of the American Society of Biological Chemists, the American Association for Cancer Research, and the American Academy of Arts and Sciences. She died of kidney cancer in 1987.

Mintz, Beatrice

b. 1921
Biologist

Education: A.B., Hunter College, 1941; student, New York University, 1941–1942; M.S., University of Iowa, 1944, Ph.D., zoology, 1946

Professional Experience: assistant, Guggenheim Dental Clinic, 1941–1942; assistant, zoology, University of Iowa, 1942–1946, instructor, 1946; instructor, biological science, University of Chicago, 1946–1949, assistant to associate professor, 1949–1960; associate member, Institute for Cancer Research (now Fox Chase Cancer Center), Philadelphia, 1960–1965, senior member, 1965–

Beatrice Mintz has been recognized for her research on cellular biology and developmental genetics, and she particularly investigated inherited susceptibility to certain tumors. Her research has focused on gene control of differentiation and disease in mammals, including, most recently, the hereditary basis of melanoma or skin



Biologist Beatrice Mintz. (Courtesy of the Fox Chase Cancer Center)

cancer. Melanoma is a highly dangerous form of skin cancer, but is difficult to detect early and treat. She is renowned for her techniques in manipulating the genetic makeup of mouse embryos and for new methods for freezing cells. After receiving her undergraduate degree, she accepted a position at the University of Iowa as assistant and instructor while she completed her doctorate. She was hired at the University of Chicago as an instructor in 1946 and advanced to associate professor in 1955. During this time, she was awarded a Fulbright research fellowship to study in France. She left Chicago in 1960 to become an associate member of the Institute for Cancer Research, now the Fox Chase Cancer Center, where she is still a senior member and researcher, and holds an endowed chair.

Mintz was elected to the National Academy of Sciences in 1973 and was named an Outstanding Woman in Science by the New York Academy of Sciences in 1993. She has received numerous awards, including the Papanicolaou Award for Scientific Achievement (1979), the first medal of the Genetics Society of America (1981), Germany's first Ernst Jung Gold Medal for Medicine (1990), the first March of Dimes Prize in Developmental Biology (1996), and a National Medal of Honor for Basic Research from the American Cancer Society (1997). She is a fellow of the American Association for the Advancement of Science, the American Academy of Arts and Sciences, and the Pontifical Academy of Sciences. She is also

a member of the Genetics Society of America, the Society for Developmental Biology, the International Society of Developmental Biology, the American Institute of Biological Sciences, and the American Philosophical Society.

Further Resources

Fox Chase Cancer Center. "Beatrice Mintz, PhD." <http://www.fccc.edu/research/pid/mintz/>.

Mitchell, Helen Swift

1895 1984
Nutritionist

Education: B.A., Mount Holyoke College, 1917; Ph.D., physiological chemistry, Yale University, 1921

Professional Experience: high school instructor, 1917–1918; director, nutrition research, Battle Creek Sanitarium, 1921–1932; professor, nutrition, Battle Creek College, 1924–1935; research professor, nutrition and home economics, Massachusetts State College, 1935–1941; principal nutritionist, Office of Defense, Health, and Welfare Services, Washington, D.C., 1941–1943; chief nutritionist, Office of Foreign Relief and Rehabilitation Operations, U.S. Department of State, 1943–1944; professor, nutrition, Carnegie Institute of Technology, 1946; dean, home economics, University of Massachusetts, 1946–1960

Concurrent Positions: exchange professor, Hokaido University, Japan, 1960–1962; research consultant, Harvard School of Public Health

Helen Mitchell was an authority on nutrition and vitamins who helped develop the idea of Recommended Dietary Allowances (or RDA), now required on all food labeling. After receiving her doctorate at Yale University, she became research director of nutrition at the Battle Creek Sanitarium in 1921 and then, beginning in 1924, served simultaneously as professor of physiology and nutrition at Battle Creek College. She was appointed a research professor at Massachusetts State College in 1935. During World War II, she took a leave from teaching to be chief nutritionist for the U.S. Office of Defense, Health, and Welfare, and then for the Department of State. It was during her tenure working for the government that Mitchell and other researchers prepared a report on nutrition and vitamin needs of enlisted men; their work led to the RDA recommendations for different groups, which eventually were applied to the population at large.

After the war, Mitchell returned to academia, first at the Carnegie Institute of Technology for a year, and then in an appointment as dean of home economics at the University of Massachusetts in 1946. She traveled widely to conduct research and attend international congresses, visiting Newfoundland, Russia, Scandinavia, Scotland, and the Middle East. She received an honorary degree from the University of Massachusetts at the time of her retirement in 1960. Even after her retirement, she was active as a consultant to the Harvard School of Public Health and as an exchange professor in Japan for two years. She was also a co-author of *Nutrition in Nursing* and of the fifteenth edition of *Nutrition in Health and Disease*, a standard textbook that has been regularly updated and reprinted for more than 70 years.

Mitchell was elected a fellow of the American Public Health Association, and was also a member of the American Dietetic Association, the American Home Economics Association, the American Institute of Nutrition, and the Institute of Food Technologists.

Mitchell, Joan L.

b. 1947

Physicist

Education: B.S., physics, Stanford University, 1969; M.S., University of Illinois, Urbana-Champaign, 1971, Ph.D., physics, 1974

Professional Experience: research staff member, International Business Machines (IBM) J. Watson Research Center, 1974–1994, research staff member, Image Applications, 1996–2007; fellow, Ricoh/IBM InfoPrint Solutions Company, 2007–

Concurrent Positions: visiting professor, University of Illinois

Joan L. Mitchell is a physicist whose work has had applications in computer science over the course of her long career in photographic image processing and technologies with IBM. She was a member and editor of the Joint Photographic Experts Group (JPEG) that developed and standardized the algorithm for color image compression, and she co-authored books in the mid-1990s on the JPEG and MPEG formats, both now standard international data compression formats. Mitchell received her doctorate in physics from the University of Illinois in 1974 and worked in various departments of the IBM T. J. Watson Research center for more than 30 years before joining the new Ricoh–IBM collaboration, InfoPrint

Solutions, as a fellow in 2007. She holds or shares more than 100 patents related to processes for photographic facsimile (fax) and image data compression.

Mitchell was elected to the National Academy of Engineering in 2004. She has received several IBM Outstanding Innovation Awards, including for Two-Dimensional Data Compression (1978), Teleconferencing (1982), Image View Facility (1985), Resistive Ribbon Thermal Transfer Printing Technology (1985), Speed-Optimized Software Implementations of Image Compression Algorithms (1991), and Q-Coder (1991), and an Outstanding Technical Achievement Award for Algorithms for Improved Printer Performance (2001). She was elected to the IBM Academy of Technology in 1997 and was named an IBM Fellow in 2001. Mitchell is a fellow of the Institute of Electrical and Electronics Engineers (IEEE). She also wrote a career-advice book, *Dr. Joan's Mentoring Book: Straight Talk about Taking Charge of Your Career* (2007).

Further Resources

"10 Minutes with Dr. Joan Mitchell, InfoPrint Fellow and Master Inventor." *InfoPrint Insights*. 8. (June 2009). Ricoh-IBM InfoPrint Solutions. http://www.infoprintsolutionscompany.com/internet/wwwsites.nsf/vwWebPublished/ii_060109_us?OpenDocument#_18.

"Joan Mitchell." IBM Women in Technology. IBM Women Fellows. http://www-03.ibm.com/ibm/history/witexhibit/wit_fellows_mitchell.html.

Mitchell, Mildred Bessie

1903–1983

Clinical Psychologist

Education: B.A., Rockford College, 1924; M.A., Radcliffe College, 1927; Ph.D., psychology, Yale University, 1931

Professional Experience: professor, education and mathematics, Lees College, 1927–1928; psychologist, George School, 1931–1933; chief psychologist, New Hampshire State Hospital, 1933–1936; vocational director, U.S. Employment Service in New Hampshire, 1936; psychologist, Bellevue Hospital, New York City, 1937; chief psychologist, Psychopathic Hospital, Iowa State University, 1938–1939; psychologist, Mt. Pleasant and Independence Street Hospitals, 1939–1941; clinical psychologist, State Bureau of Psychological Services, Minnesota, 1941–1942; member of Women Accepted for Voluntary Emergency Services (WAVES), 1942–1945; vocational appraiser, Veterans Guidance Center, City College New York, 1945–1946; psychologist, Domestic Relations Court,

New York City, 1946–1947; chief psychologist, Veterans Administration Center, Dayton, Ohio, 1951–1958; clinical psychologist, Aerospace Medical Laboratory, Wright-Patterson Air Force Base, 1958–1960, research psychologist, Bionics Section, Aeronautical Systems Division, 1960–1963; associate professor, psychology, University of Tampa, 1965–1967; lecturer, behavioral science, University of South Florida, 1967–1970

Mildred Mitchell had a distinguished career as a clinical psychologist, but she is best known for her early contributions to the development of the science of bionics. Bionics involves utilizing electronic devices and mechanical parts to assist humans in performing difficult, dangerous, or intricate tasks by supplementing or duplicating parts of the body. Tasks can range from the design of glove boxes to handling radioactive material in clean rooms to the design of artificial limbs to replace those lost to accident or disease. Bionics was a new science in the 1960s, and psychologists, biologists, physicians, chemists, physicists, mathematicians, and engineers teamed up to duplicate electronically the functions of people, animals, and plants.

Mitchell became involved in bionics in the late 1950s when she was asked by the U.S. Air Force to assist in the psychological evaluation of men competing for the astronaut training program. Initially, she was asked only to test the applicants' reaction to isolation, but later she was appointed to the selection team. The selection committee chose experienced pilots, and devised tests that simulated the pressures of high altitude and the resultant stresses on the body. The scientists knew that even experienced pilots had difficulty performing some actions such as manipulating the controls during takeoffs and landings because of high gravity (G) forces. When Mitchell was head of bionics at the Aerospace Medical Laboratory, she designed an artificial muscle that could take over such operations and could also assist if an astronaut who had experienced long periods of weightlessness found his muscles had become weak or impaired. She also designed a "nail bender" that can bend an iron nail with a puff of air. Her group designed a man-made "biological clock," which duplicates through machinery the natural mechanism that tells animals whether it is day or night, even if their environment has been artificially altered. There have been significant advances in materials, in computer simulation of muscle action, and in the need for specific bionic equipment since the beginnings of the space program. However, Mitchell and her teams early and made significant contributions to this new science.

After working with the Air Force, Mitchell accepted positions teaching at several academic institutions and, throughout her career, she was involved in improving the status of women psychologists. In 1951, she published a landmark report in the journal *American Psychologist* on the status of women psychologists who were

members of the American Psychological Association. The data indicated that women had not been elected as fellows or officers, nor had they been appointed to committees in proportion to their numbers and qualifications. She also noted that women (such as herself) changed jobs frequently due to lack of opportunities for advancement. Her report garnered some criticism, but also resulted in reforms within the profession.

Mitchell was honored with distinguished technical achievement awards of the U.S. Air Force (1962 and 1964). She was a fellow of the American Association for the Advancement of Science, the American Psychological Association, and the International Council of Women Psychologists.

Moore, Emmeline

1872–1963

Aquatic Biologist

Education: A.B., Cornell University, 1905; A.M., Wellesley College, 1906; Ph.D., Cornell University, 1914

Professional Experience: teacher, public schools, 1895–1903; instructor, biology, normal school, 1906–1910; substitute professor, botany, Huguenot College, South Africa, 1911; instructor and assistant professor, Vassar College, 1914–1919; research biologist and director of biological survey, New York Conservation Commission, 1919–1944

Emmeline Moore was an aquatic biologist and one of the few women to be appointed the director of a state fisheries department. Her research focused on the effect of fishing, disease, and pollution on fish in freshwater lakes, ponds, and rivers. Her career followed the pattern of many women in that she taught public school for several years before receiving her undergraduate degree. She was appointed an instructor in biology at a normal school after receiving her master's degree from Wellesley and substituted as a botany professor in South Africa for a year before returning to Cornell to complete her doctorate in 1914. She was appointed instructor and then assistant professor at Vassar, but joined the New York State Conservation Department in 1919 as its first female research biologist. She became chief aquatic biologist and was eventually appointed director of the survey. While her main focus was on the waterways and lakes of New York, she also conducted research projects throughout the United States and Canada, as well as in Europe and Africa. In 1926, she published a study on *Problems in Fresh Water Fisheries*. Even after her formal retirement in 1944, Moore served as an

honorary fellow at the University of Wisconsin and as a research assistant at the Yale University oceanography lab.

Moore received the Walker Prize of the Boston Society of Natural History in both 1909 and 1915. She was the first woman president of the American Fisheries Society in 1928 and was a member of the American Association for the Advancement of Science and the Ecological Society of America. In 1958, a state marine research ship, the *Emmeline M.*, was named after her.

Further Resources

Hennigan, Robert D. 2004. "Emmeline Moore: Pioneer Biologist and Fisheries Scientist." *Clearwaters*. 34(3). (Fall 2004). New York Water Environment Association, Inc. <http://www.nywea.org/clearwaters/04-3-fall/EmmelineMoore.cfm>.

Brown, Patricia Stocking. 1994. "Early Women Ichthyologists." *Environmental Biology of Fishes* 41: 9–30. (1994). <http://swfsc.noaa.gov/uploadedFiles/Education/Women%20in%20Ichthyology.pdf>.

Morawetz, Cathleen (Synge)

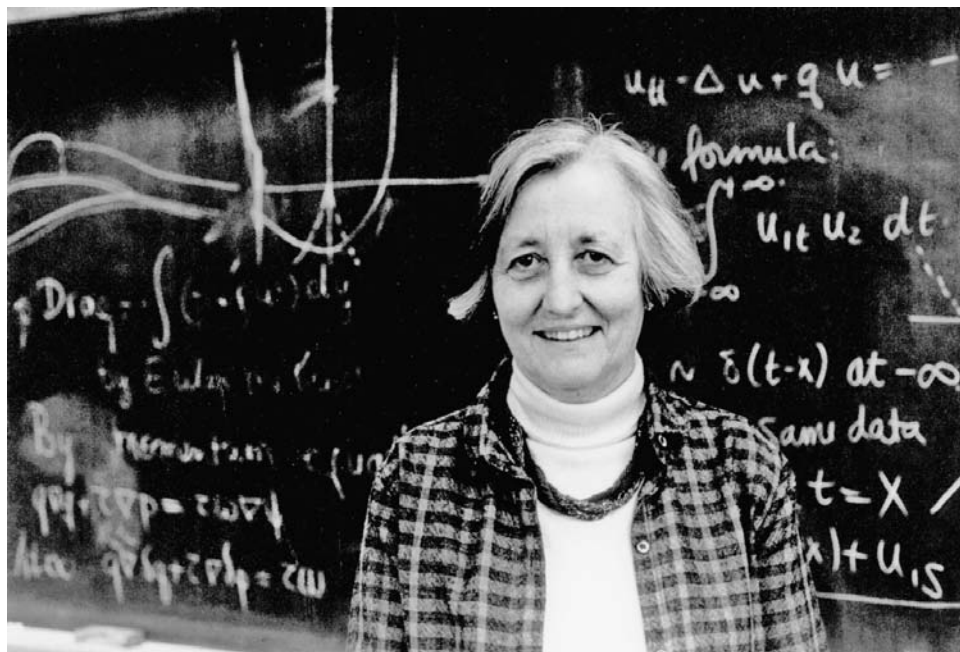
b. 1923

Applied Mathematician

Education: B.S., University of Toronto, 1944; M.S., Massachusetts Institute of Technology, 1946; Ph.D., mathematics, New York University, 1951

Professional Experience: research associate, Massachusetts Institute of Technology (MIT), 1951–1952; research associate, Courant Institute of Mathematical Science, New York University, 1952–1957, assistant to associate professor, mathematics, 1957–1966, professor, 1966–1993, associate director, Courant Institute, 1978–1984, director, 1984–1988, emerita

Cathleen Morawetz is renowned for her research in applied mathematics. She is the first woman in the United States to head a mathematical institution, the Courant Institute of Mathematical Science at NYU. Her early work involved the mathematical analysis of transonic flow, which has practical applications in the design of aircraft as it involves the study of flow past an airfoil, such as the wing of an airplane. At very fast speeds, shock waves will develop and will increase the drag on an aircraft, which has important implications for the design of supersonic aircraft. In the 1960s, her research indicated that the equations of transonic flow show that a shock wave must occur if a plane goes fast enough, no matter how the wings are designed; engineers now settle for designing airfoils with small



Mathematician Cathleen Morawetz is former director of the Courant Institute at NYU. (New York University Archives)

shocks. Later, she concentrated on the mathematics associated with the scattering of waves—electromagnetic, sound, or elastic—upon hitting a barrier. The problem was how to observe and analyze the interaction of the wave with the barrier, whether it was reflected, absorbed, or transmitted. Some applications of scattering theory are in x-ray diffraction, and mathematical analyses of high-frequency waves are the basis of techniques used in medicine to visualize internal organs as well as techniques used in geology to search for oil fields.

Morawetz's father was the mathematician John Synge, renowned for his work in tensor analysis. He did not push his daughter toward a career in mathematics, and she originally wanted to study engineering at the California Institute of Technology, but the school did not accept women at that time. She therefore concentrated on applied mathematics because she found it esthetically appealing to use mathematics to describe natural phenomena. She later obtained a temporary job at New York University in the Mathematics Department to edit mathematician Richard Courant's book *Supersonic Flow and Shock Waves* (1948). She never formally applied to the graduate school but began taking classes and eventually wrote a thesis on imploding shock waves. She gave birth to four children during her graduate and early career years and spent several years working as a

part-time researcher supported by government contracts before joining the faculty at the Courant Institute. She eventually became assistant director and then, in 1984, director of the school.

Morawetz has received eight honorary degrees, including an honorary doctorate from her own institution, New York University, in 2007. She was elected to membership in the National Academy of Sciences in 1990, the first woman member of the Applied Mathematics Section. She was named Outstanding Woman of Science by the Association for Women in Science (1993), and is a recipient of a National Medal of Science (1998), the Leroy P. Steele Prize for Lifetime Achievement by the American Mathematical Society (2004), and the Birkhoff Prize in Applied Mathematics (2006), awarded jointly by the AMS and the Society for Industrial and Applied Mathematics. She is a fellow of the American Association for the Advancement of Science and the American Academy of Arts and Sciences, and a member of the American Mathematical Society (president, 1995–1997), Society for Industrial and Applied Mathematics, and Mathematical Association of America.

Further Resources

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

Murray, Margaret Anne Marie. 2000. *Women Becoming Mathematicians: Creating an Identity in Post World War II America*. Cambridge, MA: MIT Press.

Morgan, Agnes Fay

1884–1968

Biochemist and Nutritionist

Education: B.S., University of Chicago, 1904, M.S., 1905, Ph.D., chemistry, 1914

Professional Experience: instructor, chemistry, Hardin College, 1905–1907; instructor, chemistry, University of Washington, 1910–1913; assistant to associate professor, nutrition, University of California, Berkeley, 1915–1923, professor, nutrition, 1923–1928, professor, home economics and biochemistry, 1938–1954

Concurrent Positions: biochemist, experiment station, University of California, Berkeley, 1938–1954

Agnes Fay Morgan was recognized as one of the pioneers in the development of home economics as a scientific discipline, and as one of the pioneers in nutrition research. The home economics department at Berkeley under Morgan had one of the outstanding programs in the country due to her emphasis on research and her insistence on chemistry as an integral part of the home economics curriculum. Between 1951 and 1954, she served as chair of departments at both Berkeley and Davis. She founded Iota Sigma Pi, a national society for women in chemistry. Although she had a fine record of research and teaching, she was proudest of her administrative skills in establishing a department of Household Science and Arts at Berkeley and in playing a major role in the growth of the science of home economics. Her research included the effect of heat on the biological value of proteins and the mechanism of action of vitamins. She was recognized for her pioneering work on the biochemistry of vitamins, which has had a lasting influence on research today. She was the first to produce graying of hair through vitamin deficiency and the first to note certain supplementary effects of vitamin D.

Morgan received the Garvan Medal of the American Chemical Society in 1949 for her work on vitamins, and she received the Borden Award in 1954. In 1961, the Berkeley campus named the home economics building in her honor. She received an honorary degree from the University of California in 1959. She published *Experimental Food Study* (1927, 1940). She was elected a fellow of the American Institute of Nutrition and was a member of the American Association for the Advancement of Science and the American Society of Biological Chemists.

Further Resources

King, Janet C. 2003. "Contributions of Women to Human Nutrition." *Journal of Nutrition*. 133: 3693–3697. (November 2003). <http://jn.nutrition.org/cgi/content/full/133/11/3693>.

Morgan, Ann Haven

1882–1966

Zoologist and Ecologist

Education: A.B., Cornell University, 1906, Ph.D., 1912

Professional Experience: assistant and instructor, zoology, Mount Holyoke College, 1906–1909; assistant and instructor, Cornell University, 1909–1911; associate professor, Mount Holyoke College, 1912–1913, professor, 1914–1947

Ann Morgan was a biologist and zoologist recognized for her pioneering research on ecology and conservation and wrote several popular books, including *Field Book of Ponds and Streams: An Introduction to the Life of Fresh Water* (1930), the source for information on collecting and preserving specimens for many amateur naturalists, and *Field Book of Animals in Winter* (1939). Her research included freshwater biology, respiration and ecology of aquatic insects, biology of mayflies, habits and conditions of hibernating animals, and conservation, and her students nicknamed her “Mayfly Morgan.” Morgan studied at Wellesley before transferring to Cornell University, where she received her bachelor’s degree in 1906 and her doctorate in 1912. She was a visiting scholar at numerous colleges and institutions, including the Marine Biological Laboratory at Woods Hole, Harvard University, Yale University, and the Tropical Laboratory at Kartabo, British Guiana. In the 1940s and 1950s, Morgan concentrated on reforming the science curriculum to include the topics of ecology and conservation in both schools and colleges. She gave lectures and workshops for teachers of geography, zoology, and sociology. Her last book, *Kinships of Animals and Man: A Textbook of Animal Biology* (1955), written for an introductory course in zoology, synthesized her work on this topic.

Morgan was a member of the American Association for the Advancement of Science, American Society of Naturalists, National Commission on Policies in Conservation Education, New York Herpetological Society, American Society of Zoologists, and Entomological Society of America.

Further Resources

Bonta, Marcia. 1991. *Women in the Field: America’s Pioneering Women Naturalists*. College Station: Texas A&M University Press.

Moss, Cynthia Jane

b. 1940

Wildlife Biologist

Education: B.A., philosophy, Smith College, 1962

Professional Experience: reporter and researcher, *Newsweek*, 1964–1968; veterinarian research assistant, Nairobi, 1969; research assistant, Athi Plains and Tvavo National Park, 1970; freelance journalist, 1970–1971; editor, *Wildlife News*, 1971–1985; co-director, Amboseli Elephant Research Project, Kenya, 1972–

Concurrent Positions: senior associate, African Wildlife Foundation, 1985–

Cynthia Moss is one of the foremost experts on the African elephant in the world, and, for many years, she and her associate **Joyce Poole** led the fight to stop the world trade in ivory. The illegal killing of elephants for their ivory tusks has negative effects for the entire elephant community, since it is the older lead elephants or the strongest males that are the targets of poachers. During the 1980s, Moss and Poole temporarily set aside their research projects to work with Richard Leakey to protect the elephants in Kenya and to stop the worldwide ivory trade. The three worked together to have the African elephant designated an endangered species by the Convention on International Trade in Endangered Species in 1989. Moss and Poole created a worldwide movement to ban the ivory trade by inviting photographers and newspaper reporters to visit Amboseli to photograph the elephants and tell their stories.

Moss's unique research on animals has been compared to the work of English primatologist Jane Goodall. Moss developed a method of identifying elephants by their ears, and she and her researchers have identified more than 1,400 individual elephants. Like Goodall, Moss began naming the elephants according to their families. She also studied the elephants' family structure and social patterns and became an authority on the subject. She is famous for her research that shows the male African elephants experience *musth*, a condition of increased aggression and increased sexual activity that had previously been attributed only to male Indian elephants. Along with Poole, she has also conducted pioneer studies of elephant vocalizations and identified different calls and behaviors that signal what the elephants will do—either charge or move away. Another insight Moss discovered is that, in times of drought, the elephants do not breed and therefore reduce the number of babies that will require food.

Moss fell in love with Africa on a brief visit to the country in 1967, and after working as a journalist for a number of years, she moved to Africa permanently to work with several established researchers. In 1972, she helped found the Amboseli Elephant Research Project in Kenya. Her books, *Portraits in the Wild: Behaviour Studies of East African Mammals* (1975) and *Elephant Memories: Thirteen Years in the Life of an Elephant Family* (1988; rev. ed., 2000), describe her work in Amboseli National Park. She has also contributed to children's books and wildlife documentaries on the elephants. In 2000, Moss was named one of *Time* magazine's "Heroes for the Planet."

Further Resources

Amboseli Elephant Research Project. "Cynthia Moss." <http://www.elephanttrust.org/node/41>
 Poole, Joyce. 1996. *Coming of Age with Elephants: A Memoir*. New York: Hyperion.

Murray, Sandra Ann

b. 1947

Molecular Biologist, Cell Biologist

Education: B.S., biology, University of Illinois, Chicago, 1970; M.S., biology, Texas Southern University, 1973; Ph.D., anatomy, University of Iowa, 1980

Professional Experience: instructor, biology, Texas Southern University, 1972–1973; National Institutes of Health (NIH) postdoctoral research fellow, University of California, Riverside, 1980–1982; assistant professor, anatomy, University of Pittsburgh Medical School, 1982–1989, associate professor, cell biology and physiology, 1989–

Concurrent Positions: researcher, Marine Biological Laboratory, Woods Hole Oceanographic Institution, 1986–1990; visiting scientist, Scripps Research Institute of Molecular Biology, 1991–1992; associate professor, Health Officers Institute, Office of Defense, Addis Ababa, Ethiopia, 1996–

Sandra Murray is known for her research in molecular and cell biology. She uses molecular biological, biochemical, and morphological methods to study how cells function, what brings about normal functions in a cell population, what controls the rate of cell population growth if a normal population has been injured, and how that compares with the daily process of aging and replenishing that population. She looks at what is different in cancer cell populations and examines the capacity of cells to send signals from one cell to an adjacent cell via structures called “connexins” that are associated with controlling the function of cells and the rate of cell population growth. She studies cells in culture and sometimes from human tissue taken from donors.

Murray became interested in science at a very early age. She did not feel any limitations on her career goals until she got to high school, when a counselor told her that “colored girls don’t become scientists.” While still in high school, however, she worked as a laboratory aide at the University of Illinois Medical School and was participating in Saturday science classes at the University of Illinois. After earning her B.S., she went on to graduate study at Texas Southern University and the University of Iowa, where a professor made racist comments about her ability to keep up in class. When she made good grades, he told her that her lighter skin probably indicated she had non-African blood that allowed her to do well. She transferred to a different department and received her doctorate in anatomy in 1980. Soon after, she became an assistant professor at the University of Pittsburgh Medical School, where she became the first African American to receive tenure.

Murray remains committed to encouraging women and minority students in the sciences. Recalling her own early interest in science, she also regularly serves as a mentor and judge for the National Technology Association of Science and the International Science and Engineers Fairs. She is a member of the American Society of Cell Biology (and served on the Minorities Affairs Committee), the American Society of Biological Chemists, American Association of Anatomists, Tissue Culture Association, and Endocrine Society.

Further Resources

University of Pittsburgh School of Medicine. Faculty website. <http://www.cbp.pitt.edu/faculty/murray.html>.

Ambrose, Susan A. 1997. *Journeys of Women in Science and Engineering: No Universal Constants*. Philadelphia, PA: Temple University Press.

N

Napadensky, Hyla Sarane (Siegel)

b. 1929

Combustion Engineer

Education: B.S. and M.S., mathematics, University of Chicago, ca. 1950

Professional Experience: design analysis engineer, International Harvester Company, 1952–1957; director of research, Illinois Institute of Technology (IIT) Research Institute, Chicago, 1957–1988; vice president, Napadensky Energetics, Inc., 1988–1994, engineering consultant, 1994–1998

Concurrent Positions: instructor, Mechanics Department, IIT, 1964–1966

Hyla Napadensky is a combustion engineer who spent her career as an expert in explosives and propellant safety. Her research included the study of accidental fires and explosions during the manufacture, transport, and storage of explosives, propellants, and pyrotechnics. She also studied explosive and initiation mechanisms, facility siting, and systems safety and risk analysis. After working for five years for the International Harvester Company, she began a career as director of research at the IIT Research Institute in Chicago, involved with research on a contract basis, some of it with federal agencies. Many of the studies she conducted for the government on materials used in explosive charges are probably classified as secret and therefore are not included in the standard databases. Napadensky prepared a 220-page book for the U.S. Army, *Development of Hazards Classification Data on Propellants and Explosives* (1978), and a similar book for the same agency, *Recommended Hazard Classification Procedures for In-Process Propellant and Explosive Material* (1980). As an internal publication, she prepared data on the TNT equivalency of black powder. She has also written about the risks of handling explosives on ships and in harbors.

Napadensky spent 30 years at the IIT Research Institute. She then established a consulting company, Napadensky Energetics, Inc., and formally retired in 1998. She was elected to membership in the National Academy of Engineering in 1984, and has been a National Associate of the National Academies since 2001.

Navrotsky, Alexandra A. S.

b. 1943

Geochemist, Geophysicist

Education: B.S., University of Chicago, 1963, M.S., 1964, Ph.D., chemistry, 1967

Professional Experience: research associate, theoretical metallurgy, Technische Hochschule, Clausthal, Germany, 1967–1968; research associate, geochemistry, Pennsylvania State University, 1968–1969; assistant professor, chemistry, Arizona State University, 1969–1974, associate professor, 1974–1978, professor, chemistry and geology, 1978–1985, director, Center for Solid State Science, Arizona State University, 1984–1985; professor, geological and geophysical science (affiliate in chemistry), Princeton University, 1985–1997; Interdisciplinary Professor, Ceramic, Earth, and Environmental Materials Chemistry, University of California, Davis, 1997–; director, Nanomaterials in the Environment, Agriculture, and Technology, Organized Research Unit (NEAT ORU), 2002–

Concurrent Positions: visiting research associate, James Franck Institute, University of Chicago, 1970–1971; visiting scientist, Technische Universität, Clausthal, Germany, 1972; visiting scientist, Bell Telephone Laboratories, 1974; visiting lecturer, Massachusetts Institute of Technology, 1975; visiting associate professor, University of California, Berkeley, 1976; Program Director for Chemical Thermodynamics, National Science Foundation, 1976–1977; visiting professor, State University of New York, 1981; visiting summer faculty, IBM, T. J. Watson Research Center, 1988

Alexandra Navrotsky is recognized as one of the leaders in combining mineralogical and materials research. As new technological materials become increasingly complex in structure and bonding, they are beginning to resemble the materials that make up our planet; materials science is the study of the characteristics and uses of various materials such as glass, plastics, and metals. One of the areas she has investigated is the composition of the Earth, and she points out that although humans have explored the moon, a journey to the center of the Earth remains fictional and technologically unattainable. However, mineral physics can provide some information via laboratory and computational simulations of matter under high pressure and temperature. The Earth is composed of, in descending order, the crust, the upper mantle, the transition zone, the lower mantle, the outer core, and the inner core. Navrotsky has published on the topic of thermochemistry. In 2002, she became the director of a new research institute at the University of California, Davis called NEAT: Nanomaterials in the Environment, Agriculture, and Technology. NEAT is “a multidisciplinary research and education program which links the fundamental physics, chemistry, and engineering of small particles

and nanomaterials to several challenging areas of investigation,” making applications in agricultural and environmental technology and health sciences.

Navrotsky was elected to membership in the National Academy of Sciences in 1993. Her expertise has been recognized by invitations to lecture at universities around the world. She has served on visiting committees for several institutions and scientific organizations. She was a member of the Committee on Mineral Physics of the American Geophysical Union (1983–1993) and the Committee on High Temperature Chemistry of the National Academy of Sciences (1981–1985), a fellow of the Mineralogical Society of America (President, 1992–1993), and a fellow of the American Ceramic Society (2001). In 2002, she was awarded the prestigious Benjamin Franklin Medal in Earth Science and, in 2006, the Harry H. Hess Medal of the American Geophysical Union. She is the author of *Physics and Chemistry of Earth Materials* (1994), a textbook designed for advanced undergraduates and first-year graduate students. She holds a U.S. Patent (2005) for “Methods for Removing Organic Compounds from Nano-Compositic Materials.”

Further Resources

University of California, Davis. Faculty website. <http://navrotsky.engr.ucdavis.edu/>.

Nelkin, Dorothy (Wolfers)

1933–2003

Sociologist

Education: B.A., sociology, Cornell University, 1954

Professional Experience: research associate, sociology, Cornell University, 1963–1969, senior research associate, 1970–1972, associate professor, 1972–1976, professor, Science, Technology and Society Policy Program, 1976–1990, professor, sociology, 1977–1989; professor, sociology and affiliate professor, law, New York University, 1989–2003

Dorothy Nelkin was a sociologist who wrote or co-authored more than 20 books as well as numerous papers on topics as diverse as migrant labor, nuclear power, housing innovation, university and military research, methadone maintenance, science, technological decisions, the atom, the creation controversy, animal rights, unsafe work conditions, genetics, and medical diagnosis. In her book *Workers at Risk: Voices from the Workplace* (1984), she reviewed the unsafe conditions that workers of all types encounter. Her research team interviewed workers in museums, beauty shops, research laboratories, and computer-assembly plants as well

as steel mills, auto-assembly plants, and other obvious places for dangerous working conditions. The surveyors found there was no direct link between the actual hazards and people's perceptions of risk. For example, artists and research scientists often feel that the rewards of their job outweigh the risks of handling extremely toxic chemicals. However, many workers complained they lacked information about the chemicals with which they worked. Nelkin's hope was that workplace safety would improve as a result of the survey.

Nelkin was concerned about how scientific information and tests were used to control people's lives. Her earlier book on the workplace was revised and republished under the title of *Dangerous Diagnostics: The Social Power of Biological Information* (1989), with new research from Nelkin and her researchers on the myriad tests that pronounce people healthy or ill, or likely or unlikely to suffer any of hundreds of ailments. The authors focused on the social implications of the information that these tests provide and the power that accrued to employers who administer the tests. In her book *The DNA Mystique: The Gene as a Cultural Icon* (1995; co-authored with M. Susan Lindee), she weighed in on the increasing public and political interest in human genetics in relation to social questions of intelligence, homosexuality, or criminality. The authors concluded that a reliance on DNA testing obscures efforts to solve social problems through policy or sociological support. In 2001, she and co-author Lori B. Andrews continued the discussion about who controls genetic information in their book, *Body Bazaar: The Market for Human Tissue in the Biotechnology Age*. Always interested in the relationship between science and culture, at the time of her death in 2003 she was working on new projects on science and religion and, with Suzanne Anker, on the influence of genetic science on the arts. Their book, *The Molecular Gaze: Art in the Genetic Age*, was published after Nelkin's death.

Nelkin was a consultant to the Organization of Economic Cooperation and Development (OECD, 1975–1976) and the Institute of Environment, Berlin (1978–1979), and a member of the National Advisory Council to the Human Genome Project of the National Institutes of Health (1991–1995). She was a fellow of the American Association for the Advancement of Science and a member of the Society for Social Studies of Science (president, 1978–1979). In 1993, she was elected to the Institute of Medicine of the National Academies of Science.

Neufeld, Elizabeth (Fondal)

b. 1928

Geneticist, Biochemist

Education: B.S., Queens College, 1948; student, University of Rochester, 1949–1950; Ph.D., comparative biochemistry, University of California, Berkeley, 1956

Professional Experience: postdoctoral researcher, biochemistry, University of California, Berkeley, 1956–1963; research biochemist, National Institute of Arthritis, Metabolism and Digestive Diseases, National Institutes of Health, 1963–1973, chief, Section on Human Biochemical Genetics, 1973–1979, chief, Genetics and Biochemistry Branch, National Institute of Arthritis, Diabetes, and Digestive and Kidney Diseases, 1979–1984, deputy director, Division of Extramural Research, 1981–1983; professor and chair, biological chemistry, School of Medicine, University of California, Los Angeles, 1984–2005, emeritus

Concurrent Positions: U.S. Public Health Service fellow, University of California, Berkeley, 1956–1957, assistant research biochemist, 1957–1963



Biochemist Elizabeth Neufeld has researched the genetic basis of metabolic diseases. (National Library of Medicine)

Elizabeth Neufeld is a leading international authority on human genetic diseases. Her research includes human biochemical genetics, mucopolysaccharidoses; Tay-Sachs disease; synthesis and transport of lysosomal enzymes; and inherited disorders of lysosomal functions. She provided new insights on the absence of certain enzymes that prevent the body from properly storing certain substances and has led to prenatal diagnosis of such life-threatening fetal disorders as Hurler syndrome. Her research on inherited disorders of the connective tissues focused on diseases in which cells lack certain enzymes needed to process complex sugars. The accumulation of sugars causes the cells to grow and put internal pressure on nerve tissues, which can die from too much pressure. Patients suffer from severe mental and motor deterioration, have vision and hearing problems, and die prematurely, usually before puberty. The diseases are known as the Hurler and Sanfilippo syndromes and are also related to Tay-Sachs and other diseases. After years of research, her team found that the problem was a defective gene that was causing the sugars to break down at an abnormally slow rate, and further study indicated that a series of enzymes were lacking in the patients. Her work has led to

successful prenatal diagnosis and has contributed to the availability of genetic counseling for parents. Future treatments being considered are gene replacement therapy and bone marrow transplant.

Neufeld's parents were Russian refugees living in Paris after the Russian revolution when she was born; the family moved to New York City before the Germans occupied France in 1940. Her parents stressed the importance of education because education cannot be taken away, and she became interested in science while in high school through the influence of her biology instructor. She started her scientific studies at a time when few women were choosing science as a career and there were few positions open for women—partly because of the historical bias against women in science and partly because of the influx of men returning from World War II. Few women could be found on the science faculties of colleges and universities, but she persevered in her career because she enjoyed what she was doing.

Neufeld has received numerous honorary degrees and awards. She was elected to membership in the National Academy of Sciences in 1977. She received the Lasker Award in 1982, the highest honor in the United States for medical research and which often leads to the Nobel Prize. She also won the Wolf Prize in Medicine (1988) and was awarded the National Medal of Science (1994). She is a fellow of the American Association for the Advancement of Science and a member of the American Society of Human Genetics, American Chemical Society, American Society of Biological Chemists, American Society of Cell Biology, American Society of Biochemistry and Molecular Biology (president, 1992), and American Academy of Arts and Sciences. In 1990, she was named California Scientist of the Year.

Further Resources

University of California, Los Angeles. Faculty research page. http://dgsom.healthsciences.ucla.edu/research/institution/personnel?personnel_id=45290.

New, Maria (Iandolo)

b. 1928

Pediatrician

Education: B.A., Cornell University, 1950; M.D., University of Pennsylvania, 1954

Professional Experience: medical intern, Bellevue Hospital, New York, 1954–1955; resident, pediatrics, New York Hospital, 1955–1957, National Institutes of Health fellow, pediatrics, New York Hospital, Cornell Medical Center, 1957–1958,

research pediatrician, Diabetic Study Group, Comprehensive Care Teaching Program, 1958–1961, instructor, pediatrics, 1958–1963, assistant to associate attending professor, pediatrics, 1963–1971, chief, pediatric endocrinology, Cornell University Medical College (now Joan and Sanford Weill Medical College of Cornell), 1964–2002, professor and attending pediatrician, 1971–2004, chair, pediatrics, 1980–2002, program director, Children’s Clinical Research Center, 1996–2002; professor, pediatrics and human genetics, and attending pediatrician, Mount Sinai School of Medicine, New York, 2004–, and director, Adrenal Steroid Disorders Program, 2004–

Concurrent Positions: assistant pediatrician to outpatients, New York Hospital, 1957–1959, pediatrician, 1960–1963, director, Pediatric Metabolism Clinic, 1964–2003; attending pediatrician, New York-Presbyterian Hospital (formerly New York Hospital), 1971–, pediatrician-in-chief, 1980–2002; visiting physician, Rockefeller University Hospital, New York, 1973–; consultant, Albert Einstein College of Medicine, Bronx, New York, 1974–1976; consultant, pediatrics and endocrinology, New York United Hospital Medical Center, Port Chester, New York, 1977–; adjunct attending pediatrician, Memorial Sloan-Kettering Cancer Center, 1979–1993; consultant, pediatrics, North Shore University Hospital, Manhasset, New York, 1982–; consultant, pediatrics, Catholic Medical Center of Brooklyn and Queens, 1986–; honorary member, pediatrics, Blythedale Children’s Hospital, Valhalla, New York, 1992–; consultant, Memorial Hospital for Cancer and Allied Diseases, 1993–; consultant, Memorial Sloan-Kettering Cancer Center, 1993–2006; director, pediatric endocrinology, New York-Presbyterian: University Hospital of Columbia and Cornell, 1998–2002

Maria New is an endocrinologist who specializes in pediatric endocrinology and renal diseases, juvenile hypertension, pediatric pharmacology, and growth and development from the biochemical viewpoint. She established the Maria I. New Children’s Hormone Foundation in New York as a nonprofit organization to support medical research on pediatric endocrinology and provide services and support to patients and their families. Dr. New has been affiliated with several major hospitals in the New York area as a consulting physician and has trained hundreds of new pediatricians in her specialty. She had a long career at Cornell University Medical Center before becoming professor of pediatrics and director of the Adrenal Steroid Disorders Program at Mount Sinai School of Medicine in 2004. New has edited or co-edited numerous medical textbooks as well as more than 600 research papers. She helped edit a book for the general public, the two-volume Disney *Encyclopedia of Baby and Child Care* (1995), compiled by four pediatricians. In addition to her numerous publications, she served as editor-in-chief of the *Journal of Clinical Endocrinology and Metabolism* from 1994 to 1999.

New was elected to membership in the National Academy of Sciences in 1996. She has received multiple honors and awards, including the Robert H. Williams Distinguished Leadership Award (1988), medal of the New York Academy of Medicine (1991), Maurice R. Greenberg Distinguished Service Award (1994), Humanitarian Award of the Juvenile Diabetes Foundation (1994), Dale Medal of the British Endocrine Society (1995), MERIT Award of the National Institute of Child Health and Human Development (1998), Hall of Honor of the National Institute of Child Health and Human Development (2003), and Fred Conrad Koch Award, the highest honor of the Endocrine Society (2003).

She is a member of numerous associations, such as the American Association for the Advancement of Science, New York Academy of Sciences, American Society of Human Genetics, American Academy of Pediatrics, Society for Pediatric Research, Endocrine Society (president, 1991–1992), American Fertility Society, and American Academy of Arts and Sciences, and is an honorary member of the Italian Endocrine Society.

Further Resources

Maria New Children's Hormone Foundation. <http://www.newchf.org/>.

Endocrine Society. "Maria New." <http://www.endo-society.org/about/Maria-New.cfm>.

Nice, Margaret Morse

1883 1974

Ornithologist

Education: B.A., Mount Holyoke College, 1906; A.M., psychology, Clark University, 1915

Professional Experience: independent researcher, 1915–1974

Concurrent Positions: associate editor, *Bird-Banding*, 1935–1942 and 1946–1971

Margaret Nice was an internationally known ornithologist who adapted the techniques of scientific investigation from psychology to a new area of research, that of bird behavior. Her research interests included birds of Oklahoma; life history studies of birds, particularly mourning doves, warblers, and song sparrows; and speech development of children. After receiving a master's degree in psychology, she pursued an independent interest in ornithology. Her work was supported by occasional small grants, but she never held a faculty or museum appointment. Initially, she was interested in languages as a student at Mount Holyoke College, where she received her undergraduate degree in 1906. At that time, ornithology

was taught in the zoology department and consisted of identifying dead species. Her interest shifted to psychology at Clark University, where she received her master's degree in 1915. She published 18 articles on child psychology from observations of her own children between 1915 and 1933. She began conducting field observations on birds and started corresponding with fellow ornithologists.

Nice was at the center of a network of women ornithologists whose scientific correspondence also served as a professional support system. She published approximately 250 papers and, due to her language skills, also contributed to the discipline by reviewing a large number of the leading European publications. She co-authored (with her husband, L. Blaine Nice) *The Birds of Oklahoma* (1924) and was the sole author of the two-part *Studies in the Life History of the Song Sparrow* (1937, 1943). These works established her reputation as one of the world's foremost ornithologists and bird behaviorists.

Nice was active in ornithological and conservation organizations and served as associate editor of the journal *Bird-Banding*. She published one bird book for the general public, *The Watcher at the Nest* (1939), which was reprinted in paperback. In later life, she increasingly turned her attention to educating the public about conservation and nature with lectures and talks on the radio. She often enlisted her entire family in her work; for example, her children would climb trees to observe nests for her. When the family lived in Columbus, Ohio, the local ornithology club was an all-male group and, even though by that time her work was known internationally, they invited her husband to join, but ignored her.

Nice was awarded the Brewster Medal of the American Ornithologists' Union in 1942. She was the first woman president of the Wilson Ornithological Society (1938–1939), and she was elected a fellow of the American Ornithologists' Union. She received an honorary degree from Mount Holyoke in 1955 and one from Elmira College in 1962. She published an autobiography, *Research Is a Passion with Me* (1979). She was listed in some sources as “Mrs. L. B. Nice.”

Further Resources

Bonta, Marcia. 1991. *Women in the Field: America's Pioneering Women Naturalists*. College Station: Texas A&M University Press.

Nichols, Roberta J.

1931–2005

Environmental Engineer

Education: B.S., physics, University of California, Los Angeles, 1968; M.S., environmental engineering, University of Southern California, 1975, Ph.D., engineering, 1979

Professional Experience: mathematician, missile department, Douglas Aircraft Company, 1957; mathematician, propulsion department, TRW Space Technology Laboratory, 1958–1960; research associate, Aerospace Corporation, Aerodynamics and Propulsion Laboratory, 1960–1967, Chemical Kinetics Department, 1969–1978; consultant, Synthetic Fuels Office, State of California, 1978–1979; developer of synthetic fuels, Ford Motor Company, 1979–1989, manager, alternate fuels program, 1989–1995

Roberta Nichols was a research engineer who led the U.S. automobile manufacturers in developing alternate fuels and cars to use those fuels. She worked for many years for Ford Motor Company and acquired three patents related to the Flexible Fuel Vehicle (FFV). Nichols was one of the few people who had the foresight that future clean-air laws would alter the use of fuels used to power cars and trucks. She gave lectures worldwide and served as a consultant in industry and government on issues related to low-emission and alternative energies based on alcohol, methanol-gasoline blends, hydrogen power, and battery power. She joined the Ford Motor Company in 1979 and almost singlehandedly dragged the American automobile manufacturers into the alternative fuels age. She developed ethanol-fueled engines for Ford of Brazil; designed and developed 630 methanol-fueled Escorts, which were used primarily as government vehicles; designed and developed the power train for an alternate fuel vehicle exhibited in 1982; and oversaw the development of natural-gas trucks.

Nichols became interested in alternative fuels after her father, an aerospace engineer, introduced her to racing boats. She not only held the women's world water speed record for several years in the late 1960s, but she began learning about engines and fuel performance. She earned a degree in physics from the University of California, Los Angeles (UCLA) and worked for several aerospace and aircraft companies, including establishing the Air Pollution Laboratory at Aerospace Corporation. After she became a widow with two small children to rear, she returned to school to obtain graduate degrees in engineering and then got a job at Ford. She was also a longtime board member for the Center for Environmental Research and Technology at the University of California, Riverside.

Nichols was elected to the National Academy of Engineering in 1997 and was the first woman to be elected a fellow of the Society of Automotive Engineers. She received the Outstanding Engineer Merit Award of the Institute for the Advancement of Engineering, the Aerospace Corporation's Woman of the Year Award, the Society of Women Engineers National Achievement Award (1988), a Clean Air Award for Advancing Air Pollution Technology (1989), and the Gene Ecklund Award from the U.S. Department of Energy (1996).

Nickerson, Dorothy

1900 1985

Physicist

Education: unknown

Professional Experience: assistant and assistant manager, Munsell Research Laboratory, 1921–1926; color technologist, U.S. Department of Agriculture (USDA), 1927–1964; consultant, 1965–1974

Dorothy Nickerson was a physicist and color specialist who applied color-graded standards to agricultural and horticultural products and soil. She developed the Nickerson color fan of more than 300 color samples graded by light value, hue, and chroma. The color fan or chart is important in science and industry for grading the color of products such as new strains of vegetables or cotton for textiles. At the Munsell Color Research Laboratory, Nickerson specialized in color technology and rose to the level of assistant manager. She joined the USDA in 1927 as a color technologist in the bureau of agricultural economics. She authored more than 150 papers and articles on the Munsell color system. She left the USDA in 1964 and served as a U.S. expert on color rendering for the International Commission on Illumination from 1956 to 1967. After retiring from the USDA, she formed a private consulting firm.

Nickerson received several awards, such as the Superior Service Award from the USDA (1951), the Distinguished Achievement Award of the Instrument Society of America (1964), the Gold certificate of the American Horticultural Council (1957), the Godlove Award of the Inter-Society Color Council (ISCC) (1961), and the Gold Medal of the Illumination Society of England (1970). She was a founding member of the ISCC and served as secretary (1935–1952) and president (1954–1955). In 1980, the ISCC established a Nickerson Award in her honor. She was a member of the American Association for the Advancement of Science, the Optical Society of America, and the Illuminating Engineering Society.

Nielsen, Jerri Lin

1952 2009

Physician

Education: B.A., zoology, Ohio University; M.D., Medical College of Ohio, 1977

Professional Experience: physician, 1977–1998; physician, Amundsen-Scott station, Antarctica, 1998



Jerri Nielsen was the only physician working at the Amundsen-Scott South Pole Station in Antarctica in 1998 when she diagnosed herself with breast cancer. (AP/Wide World Photos)

Jerri Lin (Cahill) Nielsen was hired to spend a year as the only physician working at the Amundsen-Scott South Pole Station in Antarctica in 1998. She attracted media attention when, during the isolated winter, she discovered a lump in her breast and had to perform her own biopsy and administer her own chemotherapy before she could leave Antarctica. A longtime private physician and emergency room doctor, Nielsen, a divorced mother of three, joined the one-year expedition as the research station's sole physician, in charge of administering basic medical care to the scientists and staff. The station is completely isolated for nine long, dark months of the year, as it is too dangerous for supply planes to land or take off on the ice. After noticing the lump in her breast, Nielsen communicated via e-mail and videoconferencing with doctors back in the United States. She used a needle to extract samples of the tumor's cells, sending the images to other doctors via computer. After confirmation that the cells were cancerous, medical supplies and drugs for her treatment were airdropped into the station. As the only physician at the station, she had to rely upon assistance from the other nonmedical personnel to administer her chemotherapy. As soon as the weather permitted, she was

airlifted back to the United States, where she underwent further treatment, including a mastectomy.

Because of the unique and dramatic nature of her ordeal, Nielsen became a popular media figure and an international motivational speaker. She wrote a book about her experience, *Icebound: A Doctor's Incredible Battle for Survival at the South Pole* (2001; with Maryanne Vollers), which was adapted as a television movie starring Susan Sarandon. She lived with the cancer for more than 10 years, but it eventually spread to her brain and she died in June 2009 in Massachusetts.

Nightingale, Dorothy Virginia

b. 1902

Organic Chemist

Education: A.B., University of Missouri, 1922, A.M., organic chemistry, 1923; Ph.D., organic chemistry, University of Chicago, 1928

Professional Experience: instructor, chemistry, University of Missouri, Columbia, 1923–1939, assistant to associate professor, 1939–1958, professor, 1958–1972

Concurrent Positions: consultant, Office of Scientific Research and Development, 1942–1945; research associate, University of California, Los Angeles (UCLA), 1946–1947

Dorothy Nightingale was a physical chemist who has been recognized for her work in organic synthetic reactions. Her research had important industry applications for the production of gasoline, synthetic rubber, cleaning products, and plastics. Nightingale was originally interested in studying history and languages, but was encouraged early on by a professor and changed her major to chemistry. She joined the faculty at the University of Missouri as one of only two women chemistry instructors after receiving her master's degree in 1923. She received her doctorate in organic chemistry from the University of Chicago in 1928, while still teaching at Missouri. She was not promoted to assistant professor until 1939 and full professor in 1958; during her tenure there, she directed the research of more than 50 graduate chemistry students. She drew upon this experience in writing *A History of the Department of Chemistry: University of Missouri-Columbia, 1843–1975*, published in 1975.

During World War II, Nightingale took a leave from the university to work as a civilian with the Office of Scientific Research and Development (OSRD). She worked with the Committee on Medical Research of the OSRD, contributing to

compound studies important in the development of antimalarial drugs for the military. She spent a year conducting research at UCLA before returning to Missouri. She retired from the University of Missouri in 1972 after nearly 50 years at that institution. Nightingale was a member of the American Chemical Society (ACS) and received the Garvan Medal of the ACS in 1959.

Northrup, Christiane

b. 1949

Physician

Education: M.D., Dartmouth Medical School, New Hampshire, 1975; diplomate, American Board of Obstetrics and Gynecology, 1981; diplomate, American Board of Holistic Medicine, 2005

Professional Experience: director, Resident's Outpatient Obstetrics and Gynecology Clinic, St. Margaret's Hospital Boston, 1979–1980; associate clinical professor, obstetrics and gynecology, Tufts University School of Medicine, 1979–1980; clinical instructor, obstetrics and gynecology, University of Vermont College of Medicine, 1979–1982, assistant clinical professor, 1982–2001; co-founder, Women to Women, Yarmouth, Maine, 1985–1997; physician, private practice, obstetrics and gynecology, Portland and Yarmouth, Maine, 1979–2005

Christiane Northrup is a physician and women's health advocate who has built an international following as a proponent of holistic healthcare and wellness through combining Western medicine, vitamins and herbal supplements, and mind–body healing. Northrup specializes in obstetrics, gynecology, and women's general health, and has written on childbirth, menopause, and breast cancer, among other topics. Her first book, *Women's Bodies, Women's Wisdom*, was published in 1994 (rev. 2006), and sold more than 1 million copies worldwide and was translated into 15 different languages. The book launched her career as a popular media figure and women's health expert, and she began to make guest appearances on shows such as the *Oprah Winfrey Show*, *Today*, *The View*, *Good Morning America*, *20/20*, and numerous other news programs. Her second bestselling book, *The Wisdom of Menopause: Creating Physical and Emotional Health and Healing during the Change* (2001; rev. 2006) was radical in taking an empowering and positive view of the changes women undergo as a new phase of life rather than focusing on only the negatives and losses. She followed with the publication of *The Secret Pleasures of Menopause* (2008). In 2005, Northrup published *Mother-Daughter Wisdom: Understanding the Crucial Link between Mothers,*

Daughters, and Health, which explores the physical and mental connection between mothers and daughters, and the effect on our health over the course of a lifetime. Her books also inspired her own public-television specials in the late 1990s and early 2000s. She has fans and followers around the world and publishes a monthly newsletter on “Women’s Health Wisdom,” and has organized a “Women’s Wisdom Community” through her popular website.

Dr. Northrup sits on a number of medical advisory boards related to women’s issues and holistic health strategies, including for *Natural Health Magazine*, *Alternative Therapies in Health and Medicine*, American Holistic Health Association, Pilates Health, Heal Breast Cancer Foundation, and A Woman’s Nation, a research and policy center founded by California First Lady Maria Shriver. Northrup is a member of the American Holistic Medical Association (AHMA) (president, 1986–1988) and the American College of Obstetrics and Gynecology. In addition to the awards and acknowledgements for her books, she has been named a Pioneer of Holistic Medicine by the AHMA (2003), and has received a Maine Media Women’s President’s Award (2003), Campaign for Better Health Celebrating Excellence Award (2003), American Heart Association’s Learn & Live Gold Heart Award (2004), Lamaze International Irwin Chabon Award (2006), and Excellence in Integrative Medicine Award from the Heal Breast Cancer Foundation (2007), among other awards. She received an honorary doctorate from the University of Maine, Farmington (2002).

Further Resources

“Christiane Northrup, M.D.” <http://www.drnorthrup.com>.

Novello, Antonia (Coello)

b. 1944

Pediatrician

Education: B.S., University of Puerto Rico, 1965; M.D., University of Puerto Rico, San Juan, 1970; M.S., public health, Johns Hopkins University School of Hygiene, 1982; diplomate, American Board of Pediatrics

Professional Experience: intern, pediatrics, University of Michigan Medical Center, 1970–1971, resident, pediatrics, 1971–1973, pediatric nephrology fellow, 1973–1974; pediatric nephrology fellow, Georgetown University Hospital, 1974–1975; physician, private practice, 1976–1978; project officer, National Institute of Arthritis, Metabolism and Digestive Diseases, National Institutes of Health (NIH),



Pediatrician and former U.S. Surgeon General, Antonia Novello. (Getty Images)

professor, pediatrics and communicable diseases, University of Michigan Medical School, 1993; adjunct professor, international health, Johns Hopkins University School of Hygiene and Public Health

Antonia Novello was the first woman to be selected Surgeon General of the United States, and also the first Hispanic person to hold that post. The Surgeon General is the nation's chief advisor on matters of public health, is a spokesperson for the president in such areas, and oversees a corps of public-health research and policy teams. Novello used the position to attract national media attention to issues such as the healthcare of minorities, women, and children; injury prevention; and the problems of domestic violence, alcohol abuse among the nation's youth, and smoking among women and young people. Although she opposed abortion, she seldom discussed the issue while Surgeon General, feeling that women should not view abortion as the only issue to tackle. Novello made headlines in 1992 when she and the executive vice president of the American Medical Association held a news conference to urge R. J. Reynolds Tobacco Company to withdraw its ads featuring the cartoon character Joe Camel because of its appeal to young people. She also attacked the practice of using sports heroes in alcohol advertising,

1978–1979, staff physician, 1979–1980, executive secretary, General Medicine Study Section, Division of Research Grants, 1981–1986, deputy director, National Institute of Child Health and Human Development, 1986–1990; Surgeon General, U.S. Department of Health and Human Services, 1990–1993; Special Representative for Health and Nutrition, UNICEF, 1993–1996; visiting professor, Health Policy and Management, Johns Hopkins School of Hygiene and Public Health, 1996–1999; Health Commissioner, State of New York, 1999–2006; vice president, Women's and Children's Health and Policy Affairs, Disney Children's Hospital, Orlando, 2008–

Concurrent Positions: clinical professor, pediatrics, Georgetown University Hospital, 1986, 1989; adjunct

targeting young people and thus encouraging underage drinking. She was also concerned about the number of children who are not vaccinated against common infectious diseases and the widespread lack of proper prenatal care.

After receiving her M.D. in Puerto Rico, Novello and her husband moved to the University of Michigan to continue their education. She then had additional training at Georgetown University before she joined the NIH. While with the NIH, she received a master's degree in public health from Johns Hopkins University and rose rapidly through the ranks of government service and policymaking. She helped draft the Organ Transplantation Procurement Act of 1984 and served on the Senate Committee on Labor and Human Resources before being appointed Surgeon General by President George H.W. Bush. After she left the Surgeon General's office, she accepted a position with UNICEF and then returned to Johns Hopkins as a visiting professor. She served as Commissioner of Health for the State of New York for seven years and in 2008 was appointed Vice President for Women's and Children's Health and Policy Affairs at Disney Children's Hospital at Florida Hospital in Orlando.

Novello has received numerous honorary degrees and awards, including the Public Health Service Outstanding Medal (1988), Surgeon General Medallion Award (1990), Alumni Award of the University of Michigan Medical School (1991), and Distinguished Public Service Award (1993). Novello was also presented with the Legion of Merit Medal by U.S. Secretary of State Colin Powell. She was inducted into the National Women's Hall of Fame in 1994. She is a member of the American Medical Association, International Society of Nephrology, and American Society of Nephrology.

Further Resources

"Antonia Novello, M.D." Academy of Achievement. <http://www.achievement.org/autodoc/page/nov0bio-1>.



Ocampo, Adriana C.

b. 1955

Planetary Geologist

Education: student, aerospace engineering, Pasadena City College, ca. 1972–1975; B.S., geology, California State University, 1983

Professional Experience: planetary geologist, Jet Propulsion Laboratory, NASA, National Aeronautics and Space Administration (NASA), 1983–1998; program executive, Office of Space Science and Office of External Relations, 1998–2002; senior research scientist, European Space Agency, Noordwijk, Netherlands, 2002–2004

Adriana Ocampo is a planetary geologist with expertise in remote sensing. She is primarily involved in applying traditional geological principles to other celestial bodies, such as stars, moons, comets, and asteroids, and to objects on Earth that are of extraterrestrial origin, such as meteorite remnants. At the Jet Propulsion Laboratory in Pasadena, California, she was involved in the *Viking* space mission to explore Mars and the outer planets and in the *Hermes* mission to explore Mercury. In 1984, she produced the only available photo atlas of Phobos, one of the moons of Mars. For the *Mars Observer* mission, she was responsible for the thermal emission spectrometer, an instrument that was supposed to measure the heat produced by the planet, thus enabling cartographers to create accurate maps. Unfortunately, the mission failed in 1993, and the instrument remained untested. As a science coordinator for the *Galileo* mission to Jupiter, she was responsible for operation of one of the spacecraft's four remote sensing instruments, the Near-Infrared Mapping Spectrometer (NIMS), which measured reflected sunlight and heat from Jupiter's atmosphere to help scientists determine the planet's composition, cloud structure, and temperature.

In the early 1990s, Ocampo and her husband, Kevin O. Pope, were part of a team sent to the Yucatan to locate the crater made by an asteroid when it impacted the Earth at the time of the Cretaceous-Tertiary (KT) boundary (65 billion years ago). The theory was that the sulfurous cloud that rose from that impact circled the Earth, blocked the sun, and killed the vegetation on which the dinosaurs and large mammals fed, causing the extinction of both. Ocampo and Pope helped verify this

theory, and their work was cited in Walter Alvarez's book, *T-Rex and the Crater of Doom* (1997).

Ocampo was born in Colombia and lived in Argentina until her family moved to California when she was a teenager. While still in high school, she obtained a summer job at the Jet Propulsion Laboratory and continued to work there during her last two years of high school and while she was in college. When she joined the lab as a full-time employee in 1983, she had already worked there 10 years. It was through her work there that she decided on a career in planetary geology. In recent years, she has held a number of high-profile research positions with NASA and other international space exploration agencies. In particular, she has worked in the recent Mars Program Science Division and has been active in educational outreach on programs related to science education for children and promoting women's careers in the sciences. In 2002, she was featured in a National Science Foundation program on "Women in Science." She is the recipient of the Woman of the Year Award in Science from the Comision Femenil (1992), Advisory Council for Women Award from the Jet Propulsion Laboratory (1996), and Science and Technology Award from the Chicano Federation (1997). In 2002, *Discover* magazine named her one of the "Top 50 Women in Science." In some sources, she appears under the name Adriana Ocampo Uria.

Further Resources

National Aeronautics and Space Administration. "Women of NASA: Adriana C. Ocampo." <http://quest.arc.nasa.gov/people/bios/women/ao.html>.

Ochoa, Ellen

b. 1958

Electrical Engineer, Astronaut

Education: B.S., San Diego State University, 1980; M.S., Stanford University, 1981, Ph.D., electrical engineering, 1985

Professional Experience: researcher, Imaging Technology Division, Sandia National Laboratory, 1985–1988; Group Leader to Chief, Intelligent Systems Branch, Ames Research Center, National Aeronautics and Space Administration (NASA), 1988–1990; astronaut, missions STS-56 (1993), STS-66 (1994), STS-96 (1999), and STS-110 (2002); deputy director, Flight Crew Operations, Johnson Space Center, 2002–2006; director, Flight Crew Operations, 2006–2007; deputy director, Johnson Space Center, 2007–

Ellen Ochoa is an electrical engineer and astronaut specializing in optics and optical recognition in robotics. While working at Sandia National Laboratory, she developed a process that implements optics for image processing that is normally done by computer. For example, one method she devised removes noise from an image through an optical system rather than using a standard digital computer to do the work. She was chosen for the astronaut program in 1990. Her first flight was in 1993 on the orbiter *Discovery* mission STS-56, which carried the Atmospheric Laboratory for Applications and Science, known as Atlas-2. She deployed instruments in space to enable scientists to look at the sun's corona, and she operated the robotic arm to deploy and retrieve the Spartan 201 satellite. Her second mission in 1994 continued the Spacelab

flight series to study the sun's energy during an 11-year solar cycle in order to learn how changes in the irradiance of the sun affect the Earth's environment and climate. For the 1999 *Discovery* mission, she was part of the team who made the first docking to the International Space Station. Her fourth flight was *Atlantis* in 2002, which again visited the International Space Station, and Ochoa was in charge of operating the robotic arm to move supplies and crewmembers.

While still a graduate student, Ochoa developed and patented a real-time optical inspection technique for defect detection, and she considers it her most important scientific achievement to date. She joined the technical staff in the Imaging Technology Division of Sandia after receiving her doctorate, and there her research centered on developing optical filters for noise removal and optical methods for distortion-invariant object recognition. She was co-author of two additional patents, one for an optical system for the nonlinear median filtering of images and another for a distortion invariant optical pattern recognition system. Since her flights as an astronaut, Ochoa has been a director of flight crew operations at NASA and, in 2007, was named Deputy Director of Johnson Space Center.



Astronaut Ellen Ochoa during test activities at the Kennedy Space Center in Florida, 2002. (NASA)

As the first female Hispanic astronaut, Ochoa quickly became a role model for young girls and Hispanics, and frequently speaks before school groups. She has received several awards, including the NASA Group Achievement Award for Photonics Technology (1991), NASA Space Flight Medal (1993), Women in Science and Engineering (WISE) Engineering Achievement Award (1994), National Hispanic Quincentennial Commission Pride Award (1990), *Hispanic* magazine's Hispanic Achievement Science Award (1991), and Congressional Hispanic Caucus Medallion of Excellence Role Model Award (1993). She is a member of the Optical Society of America and the American Institute of Aeronautics and Astronautics.

Further Resources

Kevles, Bettyann H. 2003. *Almost Heaven: The Story of Women in Space*. New York: Basic Books.

National Aeronautics and Space Administration. "Ellen Ochoa (Ph.D.)." <http://www.jsc.nasa.gov/Bios/htmlbios/ochoa.html>.

Ogilvie, Ida Helen

1874 1963

Geologist

Education: A.B., Bryn Mawr College, 1900; student, University of Chicago, 1900–1901; Ph.D., geology, Columbia University, 1903

Professional Experience: lecturer, geology, Barnard College, 1903–1905, tutor and instructor, 1905–1912, assistant to associate professor, 1912–1938, professor, 1938–1941; farm owner and operator

Concurrent Positions: director, Women's Agricultural Camp, 1917–1920

Ida Ogilvie helped expand science education for women as the founder and first chair of Barnard College's department of geology in 1903, one of the first such programs in a women's college. Her own research focused on glacial geology and petrology (rock origins), and she conducted research and mapping expeditions in Maine, New Mexico, California, New York, and Mexico.

Ogilvie attended schools in Europe before enrolling at Bryn Mawr, where she worked with **Florence Bascom** in the new geology department. After she received her doctorate from Columbia University, she was appointed the first lecturer in geology at Barnard (Columbia's women's college) in 1903, and then advanced

through the faculty ranks over the next 35 years from tutor to associate professor. Throughout her entire tenure at Barnard, she was chair of the geology department, but did not become a full professor until just a few years before her retirement. She had an interest in farming and established a Women's Agricultural Camp in Bedford, New York, recruiting female students to work there during World War I. She later purchased a 660-acre farm in Germantown, New York, where she bred cattle and horses.

Ogilvie was only the second woman elected a fellow of the Geological Society of America. She also was a member of the American Association for the Advancement of Science, the Ecological Society of America, and the New York Academy of Sciences.

Osborn, Mary Jane (Merten)

b. 1927

Molecular Biologist, Biochemist

Education: B.A., physiology, University of California, Berkeley, 1948; Ph.D., biochemistry, University of Washington, 1958

Professional Experience: postdoctoral fellow, microbiology, New York University School of Medicine, 1959–1961, instructor, 1961–1962, assistant professor, 1962–1963; assistant to associate professor, molecular biology, Albert Einstein College of Medicine, 1963–1968; professor, microbiology, University of Connecticut Health Center, 1968–

Mary Osborn was the first person to demonstrate the mode of action of a major cancer chemotherapeutic agent called *methotrexate*, an agent that also opposes the physiological effects of folic acid. She is best known for her research into the biosynthesis of a complex polysaccharide known as *lipopolysaccharide*, which is a molecule that is essential to bacterial cells and is responsible for major immunological reactions and for the bacteria's characteristic toxicity. She thus helped to identify a potential target for the development of new antibiotics and chemotherapeutic agents, especially for leukemia. She entered college as a pre-med student, but by her senior year she realized she was more interested in research than in treating patients. Her thesis research examined the functions of the vitamins and enzymes whose action depended on folic acid. As a postdoctoral student, she moved into the biosynthesis of lipopolysaccharide.



Molecular biologist Mary Osborn is one of the pioneers of immunofluorescence microscopy, a method for the observation of cell structure. (Micheline Pelletier/Sygma/Corbis)

Osborn was elected to membership in the National Academy of Sciences in 1978. She has served on numerous commissions of the National Institutes of Health, the American Heart Association, and the National Academy of Sciences, and from 1980 to 1986, she was a member of the prestigious National Science Board, the board that advises the National Science Foundation. She is a fellow of the American Academy of Arts and Sciences and a member of the American Association for the Advancement of Science, American Society of Biological Chemists (president, 1981), American Chemical Society, American Society for Biochemistry and Molecular Biology (president 1981), Federation of American Societies for Experimental Biology (president, 1982), and American Society for Microbiology.

Further Resources

University of Connecticut Health Center. Faculty website. <http://grad.uchc.edu/faculty/bios/osborn.html>.

Ostrom, Elinor

b. 1933

Economist

Education: B.A., political science, University of California, Los Angeles, 1954, M.A., 1962, Ph.D., political science, 1965

Professional Experience: visiting assistant professor, government, Indiana University, Bloomington, 1965–1966, assistant professor and graduate advisor, political science, 1966–1969, associate professor, 1969–1974, professor, 1974–1991, Arthur F. Bentley Professor of Political Science, 1991–

Concurrent Positions: co-director of the Center for the Study of Institutions, Population, and Environmental Change (CIPEC), Indiana University, 1996–2006; co-director, Workshop in Political Theory and Policy Analysis, Indiana University, Bloomington, 1973–2009, senior research director, 2009–; professor (part-time), School of Public and Environmental Affairs, Indiana University; founding director and research professor, Center for the Study of Institutional Diversity, Arizona State University, Tempe

Elinor (Lin) Ostrom is a social scientist who won the Nobel Prize in Economics in 2009 for her research on the development, self-governance, and collective action of small communities. Ostrom, the first woman to win in Economic Sciences since the prize was added in 1968, shared



Elinor Ostrom was awarded the 2009 Nobel Prize in Economic Sciences, the first woman to win the prize in this category. (The Nobel Foundation. Photo: Ulla Montan)

the award with Oliver Williamson of the University of California, Berkeley. Trained as a political scientist, Ostrom's research has focused on integrating political and economic concerns to understand how communities come together to manage resources (both natural and political) and to understand the relationship between these practices and political, economic, and ecological sustainability. Her goal is to understand what kinds of policy initiatives and institutions best support local needs. She has authored, co-authored, or edited numerous books, including, *Governing the Commons: The Evolution of Institutions for Collective Action* (1990); *Institutional Incentives and Sustainable Development: Infrastructure Policies in Perspective* (1993); *The Samaritans' Dilemma: The Political Economy of Development Aid* (2005); and *Seeing the Forest and the Trees: Human-Environment Interactions in Forest Ecosystems* (2005).

Ostrom earned a bachelor's degree in political science from UCLA in 1954, but then moved to Boston to work in a law firm for three years. She returned to Los Angeles to continue her education, earning a master's degree and then doctorate in political science in 1965 with a thesis on water management. At UCLA, she also met her future husband, political scientist Vincent Ostrom. The couple spent time in Washington, D.C., before Vincent joined the faculty at Indiana University, where Elinor taught introductory courses in American government before also being offered a tenure-track position. The Ostroms researched police forces for what was eventually a comparative study of 80 major U.S. urban centers. Their analysis focused on the importance of information and coordination at the local and even neighborhood levels, as opposed to management from above of a larger decentralized force. Frustrated with the difficulty of conducting research across several disciplines (political science, economics, sociology), the Ostroms founded the Workshop in Political Theory and Policy Analysis in 1973, which now brings together researchers and projects across the social and natural sciences. Elinor Ostrom went on to study other types of community initiatives and aid efforts, such as in farming, forestry, and fishing.

Elinor Ostrom was elected to the National Academy of Sciences in 2001, and is a fellow of the American Academy of Arts and Sciences, American Philosophical Society, and American Academy of Political and Social Science. She has been a member of the American Political Science Association (vice president, 1975–1976; president, 1996–1997), Public Choice Society (president, 1982–1984), Midwest Political Science Association (president, 1984–1985), Association for Politics and Life Sciences, and International Association for the Study of Common Property. Before being awarded the Nobel Prize in 2009, she received numerous other awards, honors, and recognitions, including the Thomas R. Dye Service Award of the Policy Studies Organization (1997), Frank E. Seidman Distinguished Award in Political Economy (1997), Lifetime Achievement Award

of Atlas Economic Research Foundation (2003), John J. Carty Award for the Advancement of Science from the National Academy of Sciences (2004), James Madison Award of the American Political Science Association (2005), Sustainability Science Award of the Ecological Society of America (2005), Cozzarelli Prize of the National Academy of Sciences (2006), William Riker Award for Understanding Institutional Diversity from the American Political Science Association (2006), Galbraith Award of the American Agricultural Economics Association (2008), and Fellowship from the Beijer Institute of Ecological Economics, Stockholm, Sweden (2007). She has received honorary doctorates from universities in Sweden, Norway, Germany, Canada, and the United States.

Further Resources

Indiana University. Faculty website. <http://www.cogs.indiana.edu/people/homepages/ostrom.html>.

Indiana University. "Elinor Ostrom: 2009 Nobel Laureate in Economic Sciences." <http://www.iu.edu/nobel/>.

Owens, Joan Murrell

b. 1933

Marine Geologist, Paleontologist

Education: B.A., art, Fisk University, 1954; M.S., counseling, University of Michigan, 1956; B.S., geology, George Washington University, 1972, M.A., 1976, Ph.D., geology, 1984

Professional Experience: reading therapist, Children's Psychiatric Hospital, University of Michigan, 1955–1957; reading specialist, English department, Howard University, 1957–1964; curriculum specialist, Education Services, Inc., 1964–1971; museum technician, Smithsonian Institute, 1972–1973; instructor to associate professor, geology and geography, Howard University, 1976–1995, associate professor, biology, 1991–1995

Joan Owens is a marine scientist who spent 20 years as an educator before returning to college to pursue a different career. She is considered the first African American woman to earn a doctorate in geology. Owens was fascinated with water animals as a child. Growing up in Florida, she had opportunities to see unusual species, such as manatees, alligators, and otters, and in high school, she dreamed of a career in marine science. However, when she entered Fisk University, she found that neither women nor African Americans were welcome in that field.

She majored instead in art, with a double minor in psychology and mathematics, and took education courses as well. She combined her interests in art and science by working as an illustrator for medical school students and then a hospital.

She was admitted to the graduate commercial art program in the School of Architecture at the University of Michigan, but she did not enjoy the program. A fellow graduate student suggested she transfer to the Bureau of Psychological Services, which is part of the School of Education, and she enjoyed her work there because she turned out to have a special talent for working with brain-damaged and emotionally disturbed children. She received a master's degree in counseling and joined the English Department at Howard University, where she taught remedial reading. When her husband's job took them to Massachusetts, she obtained a position with Education Services, Inc., where she developed new procedures and programs for teaching English to educationally disadvantaged high school students and designing college remedial programs, later transferring to the company's Washington, D.C., offices.

At the age of 37, Owens decided to change careers and returned to college to study her original passion, marine sciences. She earned another bachelor's at George Washington University and went on to receive her master's and Ph.D. in geology and zoology. For her thesis, she studied the Smithsonian Institution's collection of button deep-sea corals, and also worked at the Smithsonian as a museum technician. After completing her doctorate, she accepted a position at Howard University, where she taught geology, paleontology, and oceanography, and continued her research on the classification of corals with support from major oil companies.

Further Resources

Warren, Wini. 1999. *Black Women Scientists in the United States*. Bloomington: Indiana University Press.

P

Palmer, Katherine Hilton Van Winkle

1895 1982

Paleontologist

Education: B.S., University of Washington, Seattle, 1918; Ph.D., paleontology, Cornell University, 1925

Professional Experience: assistant geologist, University of Oregon, 1918–1922; fellow, geology, Cornell University, 1918–1920, assistant, paleontology and historical geology, 1921–1925, postdoctoral fellow, 1925–1927; curator, paleontology, Oberlin College, 1928; special lecturer, paleontology, Cornell, 1942–1945; technical expert, zoology, New York State Museum, 1945–1946; special technical expert, Redpath Museum, McGill University, 1950–1951; director, Paleontological Research Institute, Ithaca, New York, 1951–1978

Concurrent Positions: assistant professor, history of geology and paleontology, University of Washington, Seattle, 1922; special technical assistant, Provincial Museum, Quebec, 1951

Katherine Palmer was a notable paleontologist whose research interests were paleontology, stratigraphy, and conchology, in particular the study of mollusk fossils. For more than two decades, she was director of the Paleontological Research Institute in Ithaca, New York. After receiving her undergraduate degree from the University of Washington, she was appointed an assistant in geology at the University of Oregon in 1918. The same year, she became affiliated with the geology department of Cornell University, where her husband was a professor. She received her Ph.D. from Cornell in 1925 and continued to teach there until 1946. During these years, she held interim appointments at other colleges and museums, including the University of Washington, Oberlin College, McGill University, and the Provincial Museum of Quebec. In 1951, she became director of the Paleontological Research Institute, a position she retained until her retirement at the age of 83. Even after formally retiring, she continued her research into mollusk fossils until the time of her death in 1982.

Palmer received grants from several sources, including the National Science Foundation, and received numerous honors and awards. She received an honorary

degree from Tulane University and was a fellow of the Paleontology Society, the Geological Society of America, and the American Association for the Advancement of Science. She was elected president of the American Malacological Union (1960), and for many years served as secretary-treasurer, then vice president (1958), then president (1960) of the Cushman Foundation, a foraminiferal research group. She was also a member of the American Association for the Advancement of Science and the American Association of Petroleum Geologists, and an honorary member of the Society of Economic Paleontologists and Mineralogists.

Pardue, Mary Lou

b. 1933

Cell Biologist, Geneticist

Education: B.S., College of William and Mary, 1955; M.S., radiation biology, University of Tennessee, 1959; Ph.D., biology, Yale University, 1970

Professional Experience: postdoctoral fellow, Institute of Animal Genetics, University of Edinburgh, 1970–1972; associate professor, biology, Massachusetts Institute of Technology, 1972–1980, professor, 1980–, Boris Magasnik Professor of Biology, 1995–

Concurrent Positions: instructor, molecular cytogenetics, Cold Spring Harbor Laboratory, 1971–

Mary Lou Pardue is a cell biologist who is known for her work in insect genetics. Her area of specialization is the structure and function of chromosomes in eukaryotic organisms (organisms whose DNA, or deoxyribonucleic acid, which provides the information for reproduction, is contained in their cells' nuclei, or centers). Her work excludes lower organisms such as bacteria and viruses, which are prokaryotic organisms (these have their genetic material located in the cell area surrounding the nucleus, the cytoplasm). Her studies have primarily centered on the breed of fruit fly known as *Drosophila melanogaster*. Because fruit flies have very short lifetimes, the rapid succession of fruit fly generations facilitates a time-saving study of genetic developments. An added benefit is that the flies' gene activity is similar, and therefore applicable, to that of higher organisms.

In the late 1960s, while a graduate student at Yale, she and her major professor developed a technique called “*in situ* hybridization” for localizing, with intact chromosomes, specific nucleotic sequences, which determine traits imparted

during reproduction. These experiments were carried out using the chromosomes for the *Drosophila*'s salivary glands. The technique, which was designed to locate genes on the chromosomes, is used to identify the chromosomal regions of DNA that are complementary to specific nucleic acid molecules, or RNAs. Pardue later concentrated on heat-shock response, which refers to the effects of temperature on genetic activity. Studies of the fruit fly indicated that increases in its environmental temperature exceeding 10 degrees result in the suspension of some genetic activity. Her studies attempted to determine what genes are affected by the heat increase. In related research on stress response in insect muscle cells, she found that stress also resulted in suspending some genetic activity and the associated synthesis of proteins. This research is significant for its potential application in cancer treatment, for an understanding of how to turn genetic activity on and off carries potential benefits in establishing new forms of cancer therapy as well as other scientific/medical treatments.

Pardue was elected to membership in the National Academy of Sciences in 1983. She has received numerous awards, including the Esther Langer Award for Cancer Research (1977) and the Lucius Wilbur Cross Medal of Yale Graduate School (1989). She was a member of the Science Advisory Council of Abbott Laboratories, the American Cancer Society Advisory Committee on Nucleic Acids and Protein Synthesis, the Howard Hughes Medical Institute Science Review Board, and the National Research Council Board of Biology. She is a fellow of the American Association for the Advancement of Science and a member of the American Society for Cell Biology (president, 1985–1986), Genetics Society of America (president, 1982–1983), and American Academy of Arts and Sciences.

Further Resources

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

Massachusetts Institute of Technology. Faculty website. <http://mit.edu/biology/www/facultyareas/facresearch/pardue.html>.

Parsons, Elsie Worthington Clews

1875 1941

Anthropologist and Sociologist

Education: A.B., Barnard College, 1896, A.M., 1897, Ph.D., sociology, Columbia University, 1899

Professional Experience: high school teacher, 1897; fellow, Barnard College, 1899–1902, lecturer, sociology, 1902–1905; independent researcher and author, 1900–1941

Elsie Clews Parsons was recognized as one of the leading women anthropologists of the twentieth century, but began her career in sociology. Based on her early lectures at Barnard, she published her first book, *The Family* (1906), in which she used sociological arguments to make the case for equal opportunities for women. Her next work was a study of sexual practices associated with various religions, *Religious Chastity* (1913), which she wrote under a pseudonym. Her other major books of this period were *The Old Fashioned Woman* (1913), *Fear and Conventionality* (1914), *Social Freedom* (1915), and *Social Rule* (1916). Although she had thus published widely on sociological topics, the direction of Parsons's research changed around 1915 when, on a trip to the Southwest with her husband, she first encountered Native Americans. She then shifted from sociology to anthropology and began making annual extended field trips to the pueblos to interview and collect stories from native peoples.

It was considered scandalous at that time for a woman, especially a mother, to spend time in the field and live among the native peoples, as Parsons did. Her studies resulted in numerous papers and books, including her major work, the encyclopedic *Pueblo Indian Religion* (1939). She then extended her study of folklore to other groups, such as the Gullahs of the Carolina coastal islands. Parsons was interested in both original stories and cross-cultural influences. One of her last research projects was investigating the degree of Spanish influence on twentieth-century Native American cultures. Parsons's later ethnographic publications included *The Social Organization of the Tewa of New Mexico* (1929) and *Pueblo Indian Religion* (1939).

Parsons was born into a wealthy family and used her resources to pursue a life of independence and commitment to education and scholarship. She supported the founding of the Free School of Political Science (later the New School for Social Research) in New York City and was politically active as a feminist and as a pacifist during World War I. She was elected president of the American Folklore Society (1918–1920) and the American Ethnological Association (1923–1925), and was the first female president of the American Anthropological Association (1940–1941).

Further Resources

Deacon, Desley. 1997. *Elsie Clews Parsons: Inventing Modern Life*. Chicago: University of Chicago Press.

Jacobs, Margaret D. 1999. *Engendered Encounters: Feminism and Pueblo Cultures, 1879–1934*. Lincoln: University of Nebraska Press.

Lavender, Catherine J. 2006. *Scientists and Storytellers: Feminist Anthropologists and the Construction of the American Southwest*. Albuquerque: University of New Mexico Press.

Partee, Barbara (Hall)

b. 1940

Anthropologist, Linguist

Education: B.A., mathematics, Swarthmore College, 1961; Ph.D., linguistics, Massachusetts Institute of Technology, 1965

Professional Experience: assistant to associate professor, linguistics, University of California, Los Angeles, 1965–1971, associate professor, linguistics and philosophy, 1971–1972; associate professor, linguistics and philosophy, University of Massachusetts, 1972–1973, professor, 1973–1990, Distinguished University Professor, 1990–2003, emerita

Concurrent Positions: visiting professor, El Colegio de Mexico, Charles University, Prague, Moscow State University, Russian State Humanities University, University of Leipzig, University of Canterbury; fellow, Center for Advanced Study in Behavior Sciences, 1976–1977; member, Board of Managers, Swarthmore College, 1990–2002; honorary permanent guest professor, Charles University, Prague, 1995–

Barbara Partee is known for her philosophical approach to linguistics, the science of language that includes phonetics, phonology, syntax, semantics, pragmatics, and historical linguistics. Her research combines mathematical and psychological or cognitive approaches to understanding the development of language and speech. She



Anthropologist and linguist, Barbara Partee.
(Courtesy of the University of Massachusetts)

published *Fundamentals of Mathematics for Linguistics* (1978) and is the co-author of *Mathematical Methods in Linguistics* (1990). The updated volume included many of the new theories in linguistics, such as phonology and syntax, that had emerged since her first book, and included information on formal languages, grammars, and linguistic trees. Partee also co-edited *Properties, Types and Meaning* (1989), a two-volume set of essays on foundational and semantic issues in linguistics. A later book, *Quantification in Natural Languages* (1995), which she co-edited with her husband, Emmon Bach, and others, consists of 20 papers on the subject of semantics, which is the study of meaning, or the study of linguistics developed by classifying and examining change in meaning and form.

Partee's most recent book is *Compositionality in Formal Semantics: Selected Papers of Barbara Partee* (2004). She has been an invited guest lecturer at several international universities, and spends a significant amount of time conducting research in Russia, where she continues (post-retirement) to teach theoretical and applied linguistics at Russian State Humanities University and Moscow State University.

Partee was elected to membership in the National Academy of Sciences in 1989. She has received numerous grants for work, both individual and collaborative, including National Science Foundation grants, a National Endowment for the Humanities (NEH) fellowship, and the Max Planck Research Award. She has received honorary doctorates from colleges in the United States, Europe, and Russia. She has been a member or fellow of the Linguistics Society of America (president, 1986), American Philosophical Association, Association for Computational Linguistics, American Academy of Arts and Sciences, American Association for the Advancement of Science, and Massachusetts Academy of Sciences, and in 2002 was elected a Foreign Member of the Royal Netherlands Academy of Arts and Sciences.

Further Resources

University of Massachusetts. Faculty website. <http://people.umass.edu/partee/>.

Patch, Edith Marion

1876 1954

Entomologist

Education: B.S., University of Minnesota, 1901; M.S., University of Maine, 1910; Ph.D., Cornell University, 1911

Professional Experience: high school instructor, 1901–1903; instructor, entomology and English, University of Maine, 1903–1904, head, Department of Entomology, Maine Agricultural Experiment Station, 1904–1937

Edith Patch was an entomologist known as an international authority on the life histories and ecology of migratory aphids. She was one of the earliest critics of chemical pesticides. Patch grew up in Worcester, Massachusetts, and then on a 10-acre farm in Minnesota, where she spent her early years exploring nature and studying local wildlife and insects. As a high school student, she wrote a prize-winning report on the monarch butterfly. She went on to college at the University of Minnesota, where she became interested in aphids and their effect on agriculture. Like many college-educated women of her generation, the primary job available to her after graduation was as a school teacher, and she taught high school for two years while pursuing work as an entomologist. She secured a position at the University of Maine, where she remained affiliated for the remainder of her career, teaching English and entomology before founding and becoming head of the new Department of Entomology at the Maine Agricultural Experiment Station in Orono (which was affiliated with the University). She was named the director of the station in 1924. During this same time, she began her graduate education, earning a master's degree in 1910 and a doctorate from Cornell in 1911. Her scientific publications included 15 books and nearly 100 papers, and two new genera and several species of insects were named in her honor. Her most important publication was her 1938 *Food-Plant Catalogue of the Aphids of the World*, still an important reference book.

After Patch's formal retirement, she wrote a number of nature books for children. She was also committed to the science education of women and wrote papers on entomology as a career for women. She received an honorary doctorate from the University of Maine (1937), and was a member of the American Association for the Advancement of Science and the American Society of Naturalists, and served as president of both the Entomological Society of America (1936) and the American Nature Study Society (1937).

Further Resources

Bonta, Marcia. 1991. *Women in the Field: America's Pioneering Women Naturalists*. College Station: Texas A & M University Press.

Paté-Cornell, (Marie) Elisabeth Lucienne

b. 1948

Industrial Engineer

Education: B.S., mathematics and physics, University of Marseilles, 1968; M.S. and engineer degree, computer science and applied mathematics, Polytechnic

Institute of Grenoble, 1970 and 1971; M.S., operations research, Stanford University, 1972, Ph.D., engineering-economic systems, 1978

Professional Experience: engineer-economist, Régie Autonome des Transports de Paris, France (Transportation Planning), 1972–1973; assistant professor, civil engineering, Massachusetts Institute of Technology (MIT), 1978–1981; assistant professor, industrial engineering and engineering management, Stanford University, 1981–1984, associate professor, 1984–1991, professor, management science and engineering, 1991–1999, Burt and Deedee McMurtry Professor of Engineering, 1999–, professor and chair, management science and engineering, Stanford University, 2000–

Concurrent Positions: senior fellow, Institute of International Studies, Stanford University, 2000–

Elisabeth Paté-Cornell is known for her research in engineering systems analysis that is combined with economic analysis to assess risk and find realistic solutions to real-world problems. In pulling together what had been thought to be separate disciplines to offer a unique approach to problems, she has drawn on her studies in mathematics and physics, computer engineering with an electrical engineering component, economics, and operations research. Operations research (OR), which was developed around 1940 to 1945, during World War II, for military operations, is the analysis,



Industrial engineer, Elisabeth Paté-Cornell. (Courtesy of the Stanford University News Service Library)

usually involving mathematical treatment, of a process, problem, or operation to determine its purpose and effectiveness and to gain maximum efficiency. For her doctoral dissertation, she studied seismic risk from a public-policy viewpoint, looking at the costs and benefits of reducing earthquake risks. Her more recent research has had applications in industrial, medical, and government programs, including assessing National Aeronautics and Space Administration (NASA) shuttle missions and government intelligence regarding terrorist attacks. In 1998, she was a member of the Marine Board of the National Research Council (NRC), a committee on risk assessment and management of marine systems, such as offshore platforms.

Born in Senegal, she attended high schools in both Senegal and France, where she was influenced toward studying science by her engineer father. She earned degrees in mathematics, physics, and computer science before coming to Stanford University in California in 1971 to study in the interdisciplinary program of engineering and economic systems. She became a U.S. citizen in 1986, by which time she was an assistant professor at MIT, before returning again to Stanford as a faculty member in 1981. She has led the department of Management Science and Engineering at Stanford since 2000.

Paté-Cornell was elected to the National Academy of Engineering in 1995. She has served on the President's Foreign Intelligence Advisory Board (2001–2004) and has been a member of the Advisory Council of NASA's Jet Propulsion Laboratory and the Board of Trustees of the Aerospace Corporation since December 2004. She has also served as a member of the Army Science Board, the NASA Advisory Council, and the Air Force Scientific Advisory Board, and is a member of the Society for Risk Analysis (president, 1995) and the Institute for Operations Research and Management Science (INFORMS). She is the recipient of a Distinguished Achievement Award from the Society for Risk Analysis (2002) and was elected to the French Académie des Technologies in 2003.

Further Resources

Stanford University. Faculty website. <http://www.stanford.edu/dept/MSandE/people/faculty/mep/index.html>.

Patrick, Jennie R.

b. 1949

Chemical Engineer

Education: student, Tuskegee Institute, 1969–1970; B.S., chemical engineering, University of California, Berkeley, 1973; Ph.D., chemical engineering, Massachusetts Institute of Technology, 1979

Professional Experience: research engineer, General Electric Research and Development Center, 1979–1983; project manager, Phillip Morris Company, 1983–1985; department manager, fundamental chemical engineering research, Rohm and Haas Company, 1985–1990; assistant to executive vice president, Southern Company Services, 1990–1993; 3M Eminent Scholar and Professor of Chemical Engineering, Tuskegee Institute, 1993–1997; senior consultant, Raytheon Engineers and Constructors (Washington Group International), Alabama, 1997–

Concurrent Positions: assistant engineer, Dow Chemical Company, 1972; Stauffer Chemical Company, 1973; Chevron Research, 1974; Arthur D. Little, 1975; adjunct professor, Rensselaer Polytechnic Institute, 1982–1985, and Georgia Institute of Technology, 1983–1987

Jennie Patrick is a chemical engineer, manager, and educator who has worked in a variety of research, industry, and academic settings. She was the first African American woman to earn a doctorate in chemical engineering, which she received at the Massachusetts Institute of Technology (MIT) in 1979. Her working-class parents emphasized to their five children that knowledge was an escape from poverty. Jennie attended segregated elementary and middle schools, but in high school, she was one of the first participants in an integrated school in her hometown in Georgia. She wanted to attend the integrated school because it had all the scientific equipment she needed for her studies, while the school for blacks had none. She entered Tuskegee Institute as a chemistry major but transferred to the University of California, Berkeley to complete her undergraduate degree. She began working for chemical companies to support herself while still in school. She then went to MIT to obtain her doctorate in chemical engineering with research on superheating, in which a liquid is raised above its boiling temperature but does not become a vapor. She investigated the temperature to which pure liquids and mixtures of two liquids could be superheated.

After receiving her Ph.D., Patrick joined the General Electric Research and Development Center, where her work involved research on energy-efficient processes for chemical separation and purification, particularly the use of supercritical extraction. She worked for several other corporations, as well as taking positions as an adjunct professor, before returning to academia full-time as an endowed chair and professor chemical engineering back at the Tuskegee Institute. At Tuskegee, she was committed to helping minority students find success, particularly in the fields of science and engineering. In 1997, she returned to industry as an engineering consultant at Raytheon.

Patrick received the Outstanding Women in Science and Engineering Award (1980) and the Black Achievers in Chemical Engineering Award of the American

Institute of Chemical Engineers (2008). She is identified in some sources as Jennie Patrick-Yeboah.

Further Resources

Williams, Clarence G. 2003. *Technology and the Dream: Reflections on the Black Experience at MIT, 1941–1999*. Cambridge, MA: MIT Press.

Patrick, Ruth

b. 1907

Botanist, Limnologist

Education: B.S., Coker College, South Carolina, 1929; M.S., University of Virginia, 1931, Ph.D., botany, 1934

Professional Experience: assistant, Coker College, 1929; assistant, research, Temple University, 1934; phycology researcher and volunteer curator, Academy of Natural Sciences, Philadelphia, 1933–1937, associate to assistant curator, Leidy Microscopical Collection, 1939–1947, chair (and founder), department of limnology, 1947–1973, curator, 1947–, Francis Boyer research chair, 1973–

Concurrent Positions: lecturer, Marine Biological Laboratory, Woods Hole, Massachusetts, 1951–1955; lecturer, botany, University of Pennsylvania, 1952–1970, adjunct professor, 1970–

Ruth Patrick is a botanist and limnologist, or hydrobiologist, a multidisciplinary scientist who studies freshwater ecosystems. Patrick's specific expertise has been on the biodynamic cycle of rivers, and on the taxonomy, ecology, and physiology of diatoms, a family of microscopic one-celled algae that is the basic food for many organisms in the freshwater ecology. She was employed as an assistant at Coker College and Temple University before receiving her doctorate in botany from the University of Virginia in 1934. Soon after, she began her long career with the Academy of Natural Sciences in Philadelphia, leading expeditions to build the world-renowned collection of the Diatom Herbarium and becoming founding chair and curator of a new Department of Limnology there in 1947 (a department now known as the Patrick Center for Environmental Research). Although she

celebrated her one-hundredth birthday in November 2007, she has never formally retired and still maintains an affiliation with the Academy.

Patrick's invention of a device called the *diatometer* made it possible for the first time to determine accurately the presence of pollution in fresh water. For many years, she was a consultant for government and corporate projects, assessing the ecological impact of nuclear power plants, groundwater pollution, and acid rain. In 1975, she became the first woman to sit on the board of directors of the Du Pont company. Along with **Rachel Carson**, Patrick was among the scientists largely responsible for calling attention to such ecological concerns in the mid-twentieth century; she published a book on the topic, *Groundwater Contamination in the United States*, in 1983.

Patrick was elected to membership in the National Academy of Sciences in 1970 and received the National Medal of Science in 1996. She has received more than 25 honorary degrees and an astonishing list of awards and honors from government, industry, and citizen's groups. The most prestigious of these include a \$150,000 John and Alice Tyler Ecology Award (1975), Public Service Award from the U.S. Department of the Interior (1975), Golden Medal of the Royal Zoological Society of Antwerp, Belgium (1978), Founders Award of Society of Environmental Toxicology and Chemistry (1982), Commonwealth of Pennsylvania Governor's Award for Excellence in the Sciences (1988), Benjamin Franklin Award for Outstanding Scientific Achievement from American Philosophical Society (1993), Lifetime Achievement Award from American Society of Limnology and Oceanography (1996), Mendel Medal from Villanova University (2002), Chairman's Medal of the Heinz Family Foundation (2002), and Lifetime Achievement Award from the National Council for Science and the Environment (2004). She has been a member of the Phycological Society of America (president, 1954–1957), American Society of Naturalists (president, 1975–1977), American Philosophical Society, Botanical Society of America, South Carolina Academy of Sciences, American Academy of Arts and Sciences, American Society of Limnology and Oceanography, American Institute of Biological Sciences, Ecological Society of America, and American Society of Plant Taxonomists.

Further Resources

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

Patrick Center for Environmental Research, Academy of Natural Sciences. "Dr. Ruth Patrick." <http://www.anasp.org/research/pcer/rp/index.php>.

Patterson, Flora Wambaugh

1847 1928

Plant Pathologist

Education: A.B. Antioch College, 1860; M.L.A., Cincinnati Wesleyan College, 1865, A.M., 1883; A.M., University of Iowa, 1895

Professional Experience: assistant, Gray Herbarium, Harvard University, 1895; private school instructor, 1896; assistant pathologist, herbarium, U.S. Department of Agriculture (USDA), 1896–1901, mycologist, pathological collections, Bureau of Plant Industry, 1901–1923

Flora Patterson was a plant pathologist whose research included fungal diseases of plants and insects and systemic mycology. She was only the second woman scientist employed by the USDA; the first was Effie (Southworth) Spalding. Patterson worked as an assistant at the Gray Herbarium at Harvard University and as a private school teacher before obtaining a position at the USDA in 1896, where she remained until retiring in 1923. One benefit for women scientists working at the USDA in the early twentieth century was that, unlike in many academic research labs, they were able to publish their research under their own names. Patterson published numerous papers on her mycological research in addition to the pamphlets she prepared for the USDA series. She was co-author of *Mushrooms and Other Common Fungi* (1915), with fellow mycologist **Vera Charles**, and she wrote a chapter on “The Plant Pathologist” for a 1920 guide to *Careers for Women* (edited by Catherine Filene).

After college, Patterson married and had two children. When her husband became debilitated and then died, Patterson was forced to find a way to support herself and her children. She returned to college and received another master’s degree from Cincinnati Wesleyan, then on to continue her studies at the University of Iowa, where she became interested in botany. She moved to Massachusetts with her brother, and studied botany at Radcliffe for three years and became an assistant at the Gray Herbarium at Harvard. During this time, she also became interested in mycology and served as assistant editor of *Economic Fungi*. She received another master’s degree from the University of Iowa in 1895 and began teaching biology at a private school in Boston. Soon after, she began working for the USDA as a vegetable pathologist and then as a mycologist overseeing collections for the new Bureau of Plant Industry.

Patterson was a member of the American Association for the Advancement of Science, the American Phytopathological Society, and the Botanical Society of America.

Further Resources

Rossman, Amy Y. 2002. "Flora W. Patterson: The First Woman Mycologist at the USDA." *The Plant Health Instructor*. APSnet Education Center. <http://www.apsnet.org/education/feature/patterson/>.

Payne, Nellie Maria de Cottrell

1900 1990

Entomologist and Agricultural Chemist

Education: B.S., Kansas State Agricultural College, 1920, M.S., 1921; Ph.D., zoology, University of Minnesota, 1925

Professional Experience: assistant zoologist and entomologist, Kansas State Agricultural College, 1918–1921; instructor, science and math, Lindenwood College, 1921–1922; assistant and librarian, entomology, University of Minnesota, 1925–1930, lecturer, 1933–1937; National Research Foundation fellow, University of Pennsylvania, 1925–1927; scientific staff, *Biological Abstracts*, 1927–1933; assistant research entomologist, American Cyanamid Company, 1937–1943, entomologist, 1943–1944, zoologist, 1944–1957; literature chemist, Velsicol Chemical Corporation, 1957–1971; consultant

Concurrent Positions: National Research Council fellow, zoology, University of Pennsylvania, 1925–1927; research investigator, University of Vienna and University of Berlin, 1930–1931

Nellie Payne was an entomologist and agricultural chemist whose research interests included hydroid pigments, hibernation and low-temperature effects in insects, and the mathematics of population growth. She had a varied career, involving both academic and corporate appointments. She was employed as an assistant zoologist and entomologist while she was working toward both her bachelor's and master's degrees at Kansas State. She taught for one year in chemistry and mathematics at Lindenwood College, then received an appointment as assistant entomologist while she completed her doctorate in invertebrate zoology at the University of Minnesota. After positions as a fellow at the University of Pennsylvania and a member of the scientific staff of the major index *Biological Abstracts*, she returned to Minnesota as a lecturer for five years. She was appointed entomologist and zoologist in research at American Cyanamid in 1937. In 1957, she accepted a position as a literature chemist at Velsicol Chemical, then became a consultant starting in 1971. Payne also worked for the Entomological Society

of America. Prior to the 1960s, many women scientists were employed as indexers and abstracters rather than in research positions in industry. Today, corporations hire both men and women scientists in their information centers to keep abreast of both the internal and external research data.

Payne was elected a fellow of the American Association for the Advancement of Science, the Entomological Society of America, and the American Institute of Chemists. She also was a member of the American Chemical Society, the Biometric Society, the Zoological Society of America, and the New York Academy of Sciences.

Payne-Gaposchkin, Cecilia Helena

1900 1979

Astronomer

Education: A.B., natural sciences, Newnham College, Cambridge University, 1923; Ph.D., astronomy, Radcliffe College, 1925

Professional Experience: National Research Fellow, Harvard University, 1925–1927, astronomer, Harvard College Observatory, 1927–1938, Phillips Astronomer, 1938–1967, Phillips Professor and Chair, astronomy, Harvard University, 1956–1967; staff member, Smithsonian Astrophysical Observatory, 1967–1979

Cecilia Payne-Gaposchkin, an authority on variable stars and galactic structure, was the first woman to achieve the rank of full professor at Harvard. Early in her career, she developed new techniques for ascertaining stellar magnitudes from photographic plates. She applied these techniques to a large collection of photographic plates dating back to 1890 that were stored at the observatory. In the mid-1930s, she concentrated on the study of variable stars. Her research team made several million observations over the entire sky. She often collaborated with her husband, Sergei I. Gaposchkin, and other staff members, and published more than 300 papers on galactic structure and novae. In addition to her scientific publications, she was the author of several books, including *Variable Stars* (1938), *Stars in the Making* (1952), *Variable Stars and Galactic Structure* (1954), and *Galactic Novae* (1957).

After receiving her undergraduate degree from Cambridge in 1923, she won a National Research Fellowship to study at Radcliffe and to work at the Harvard College Observatory, where she spent her entire career. In 1925, she was the first scholar at Radcliffe to receive a doctorate in astronomy, changing the career pattern for women astronomers (many of whom received degrees in physics) and

broadening their research and employment opportunities. She continued working at the observatory and was appointed a permanent member of the staff in 1927. At the time, there were numerous other prominent women astronomers working at Harvard, including **Annie Jump Cannon**, **Antonia Maury**, and others. Payne-Gaposchkin was eventually promoted to full professor of astronomy and chaired the department at Harvard. After she retired in 1967, she became a staff member at the Smithsonian Astrophysical Observatory.

Payne-Gaposchkin received the first Annie J. Cannon Prize of the American Astronomical Society (AAS) (1935) and was the first woman to give the Henry Norris Russell Prize Lecture of the AAS (1976), the Society's highest honor for lifetime achievement in astronomy. She received honorary doctorates from Wilson College (1942), Smith College (1943), Western College (1951), Cambridge University (1952), Colby College (1958), and Women's Medical College of Philadelphia (1961). She was a member of the American Astronomical Society, the American Philosophical Society, the American Academy of Arts and Sciences, and the Royal Astronomical Society.

Further Resources

Byers, Nina and Gary A. Williams. 2006. *Out of the Shadows: Contributions of Twentieth-Century Women to Physics*. New York: Cambridge University Press.

Payton, Carolyn (Robertson)

1925–2001

Psychologist

Education: B.S., home economics, Bennett College, 1945; M.S., clinical psychology, University of Wisconsin, Madison, 1948; Ed.D., counseling and administration, Teachers College, Columbia University, 1962

Professional Experience: instructor, psychology, Livingstone College, North Carolina, 1948–1953; dean of women and instructor, psychology, Elizabeth City State Teachers College, North Carolina, 1953–1956; associate professor, psychology, Virginia State College, 1956–1959; assistant professor, psychology, Howard University, 1959–1964; Chief Field Selection Officer, U.S. Peace Corps, 1964–1966; deputy director, Peace Corps Eastern Caribbean Section, 1966–1971; assistant professor and director, Counseling Services, Howard University, 1971–1977; director, U.S. Peace Corps, 1977–1978; dean, counseling and career development, Howard University, 1978–1995

Carolyn Payton was a psychologist known for her work in counseling and career development, and served for one year as the first black and the first female director of the U.S. Peace Corps. When the Peace Corps was formed in 1961, it was charged with sharing technical skills with requesting countries. Trained volunteers spent two years in host countries working primarily in the areas of agriculture, rural development, health, and education. At first, the corps sent volunteers to Latin America, Africa, and the Middle East, but after 1990 and the end of the Cold War, Eastern Bloc countries also began requesting volunteers. Payton joined the Peace Corps in 1964 as a field selection officer and progressed in rank until she was deputy director of the Eastern Caribbean Section in 1966. She returned to Howard University to teach until 1977, when she was named by President Carter director of the Peace Corps. At that time, most recruits were experienced, highly skilled persons who could fill the specialized needs of developing countries; however, they tended to “teach down” to the people they were sent to help. Payton planned a program to train the volunteers to be better teachers and planned to recruit more blacks, women, and college graduates from varied backgrounds for the program. The Peace Corps was no longer an autonomous organization, however, and it was being administered by the American Council to Improve Our Neighborhoods (ACTION), whose head did not agree with her plans. Payton was forced to resign. However, her resignation had a positive impact in that President Carter restored the Peace Corps to an independent agency in 1981.

Payton worked to promote world understanding through cross-cultural interactions in both public and private forums. She was convinced that the inequalities in America were related to worldwide problems of poverty, hunger, and illiteracy, and was committed to the idea that professional scientists had an ethical imperative to work for social justice. She published a 1984 article in *American Psychologist* entitled “Who Must Do the Hard Things?,” in which she argued that the discipline of psychology must have application to social problems and policy. She urged psychologists to “place our talents, our expertise, and our energy in the service of our conscience as well as our discipline.” She was involved in the Public Policy Committee of the American Psychological Association (APA) and supported psychological research and education through the establishment of a scholarship fund at her alma mater, Bennett College.

Payton was a fellow of the APA and was awarded the APA’s Distinguished Professional Contributions Award (1982) and the APA Committee on Women in Psychology Leadership Citation Award (1985). The APA honored her again in 1997 with the Award for Outstanding Lifetime Contribution to the field of psychology.

Further Resources

Keita, Gwendolyn P. 2001. “Carolyn Robertson Payton (1925–2001).” *The Feminist Psychologist*. 28(3). Newsletter of the Society for the Psychology of Women, Division 35

of the American Psychological Association. (Summer 2001). <http://www.psych.yorku.ca/femhop/Carolyn%20Robertson%20Payton.htm>.

O'Connell, Agnes N. and Nancy Felipe Russo, eds. 1988. *Models of Achievement: Reflections of Eminent Women in Psychology*. Vol. 2. Hillsdale, NJ: Lawrence Erlbaum Associates.

Pearce, Louise

1885 1959

Pathologist

Education: A.B., physiology, Stanford University, 1907; student, Boston University School of Medicine, 1907–1909; M.D., Johns Hopkins University School of Medicine, 1912

Professional Experience: intern, Johns Hopkins Hospital, 1912; fellow, Rockefeller Institute for Medical Research, 1913–1923, associate member, 1923–1951

Concurrent Positions: visiting professor, syphilology, Peiping Union Medical College, China, 1931–1932; president, Women's Medical College of Philadelphia, 1946–1951

Louise Pearce was one of the foremost American women scientists of the early twentieth century and one of the principal figures in developing the drug tryparsamide to control African sleeping sickness. Her results, in collaboration with pathologist Wade Hampton Brown, were published in the *Journal of Experimental Medicine* in 1919, and she went to Africa in 1920 to supervise tests of the drug on humans. She spent her entire career at the Rockefeller Institute for Medical Research after receiving her medical degree from the Johns Hopkins University School of Medicine. Her other work included the biology of infectious and inherited diseases, such as syphilis and smallpox. In her study of syphilis in rabbits, she found that it closely resembled the human variety. The observations were therefore valuable to students of immunity and to physicians engaged in treating syphilitic patients. She and her collaborators found a tumor in rabbits that was capable of being grown in a laboratory and transplanted. The Brown-Pearce tumor was subsequently studied in cancer laboratories throughout the world. The breeding program and studies led the research team to isolate a virus similar to human smallpox when an epidemic of rabbit pox nearly destroyed the carefully developed rabbit colony. In the 1930s, the team enlarged its breeding program for rabbits, and by 1940, more than two dozen hereditary diseases and deformities were

represented in the rabbit colony. Unfortunately, many of Pearce's files were destroyed after her death, and she had not completed writing up the results of all of her research.

Pearce also worked to advance the cause of women in medicine and science, and served as a member of the board of the Women's Medical College of Philadelphia from 1941 to 1946, and as president from 1946 to 1951. She also served on the scientific advisory council of the American Social Hygiene Association. She received several honors from the Belgian government for her work on sleeping sickness in the Belgian Congo (now Zaire), including the Ancient Order of the Crown, membership in the Belgian Society of Tropical Medicine, and the King Leopold II Prize in 1953.

Further Resources

National Institutes of Health. "Dr. Louise Pearce." Changing the Face of Medicine: Celebrating America's Women Physicians. National Library of Medicine, National Institutes of Health. http://www.nlm.nih.gov/changingthefaceofmedicine/physicians/biography_248.html.

Peckham, Elizabeth Gifford

1854 1940

Arachnologist and Entomologist

Education: B.A., Vassar College, 1876, A.M., 1889; Ph.D., Cornell University, 1916

Professional Experience: independent researcher

Elizabeth Peckham was an early entomologist and taxonomist recognized by her contemporaries for her research on spiders and wasps, fields known as *arachnology* and *hymenoptera*. Before receiving her doctorate, she collaborated and co-authored numerous papers and articles with her husband, entomologist George Williams Peckham, a high school biology teacher and public-library director with a medical degree. George Peckham was an innovator in emphasizing scientific research in secondary school, and the couple met when she came to work in his high school laboratory. They lived and worked in Wisconsin, and many of their publications were issued by organizations such as the Natural History Society of Wisconsin, the Wisconsin Geological Survey, and the Wisconsin Academy of Sciences, Arts, and Letters. Elizabeth Peckham had a solid educational background, with undergraduate and master's degrees from Vassar. After George Peckham's death in 1914, she

returned to New York to pursue a doctorate from Cornell University, which housed one of the preeminent programs in entomology in the nation. She earned her Ph.D. from Cornell in 1916, at the age of 62.

In 1898, the Peckhams published a book, *On the Instincts and Habits of Solitary Wasps*. Influenced by the new theories of Charles Darwin on adaptability and variability within species, they also published research in the new field of insect psychology, emphasizing insect behavior and not just physical characteristics in some of the first papers on the mental powers of spiders and courtship and sexual selection among insects. Elizabeth Peckham was listed as the primary author of their 1905 book, *Wasps Social and Solitary*, which details their firsthand observations of wasp communities and the working habits of wasps. Among their important discoveries detailed in this book was the use of tools by one species of wasps.

Elizabeth and George Peckham have a distinguished legacy as early arachnologists. A genus of jumping spiders, *Peckhamia*, is named in their honor, as well as 20 individual species and subspecies. The Peckham Society was founded in 1977 to honor their work and to bring together both amateur and professional scientists interested in studies of salticid, or jumping spiders.

Further Resources

Bonta, Marcia. 1991. *Women in the Field: America's Pioneering Women Naturalists*. College Station: Texas A & M University Press.

The Peckham Society. <http://peckhamia.110mb.com/>.

Peden, Irene (Carswell)

b. 1925

Electrical Engineer, Radio Scientist

Education: B.S., University of Colorado, 1947; M.S., Stanford University, 1957, Ph.D., electrical engineering, 1962

Professional Experience: junior engineer, Delaware Power and Light Company, 1947–1949; junior engineer, Aircraft Radio Systems Laboratory, Stanford Research Institute, 1949–1950, research engineer, 1950–1952, antenna research group, 1954–1957; research engineer, Midwest Research Institute, 1953–1954; research assistant, Hansen Laboratory, Stanford University, 1958–1961, acting instructor in electrical engineering, 1959–1961; assistant to associate professor, University of Washington, Seattle, 1961–1971, professor, 1971–, associate dean of engineering, 1973–1977, associate chair, Electrical Engineering Department, 1983–1986

Irene Peden is a specialist in radio science and electromagnetic waves who conducted geophysical studies of radio wave propagation through the Antarctic ice pack, and she was the first American woman scientist to live and work in the interior of that continent. At the Byrd Antarctic Research Station in the 1970s, she developed new methods to analyze the deep glacial ice by studying the effect it has on radio waves directed through it, and she has continued this line of research by studying certain properties in the lower ionosphere over Antarctica. She developed the methodology for her own experiments and invented the mathematical models needed to study and interpret the data the team collected. She and her students were the first researchers to measure many of the electrical properties of Antarctic



Electrical engineer and radio scientist, Irene Peden. (Courtesy of University of Washington/UnivPhoto)

ice and to describe important aspects of very low frequency (VLF) propagation over long paths in the polar region. Later, she turned her attention to subsurface exploration technologies, using very high frequency (VHF) radio waves to detect and locate subsurface structures and other targets.

Although women scientists from other countries had been conducting research at their countries' research stations in Antarctica for a number of years, American women were excluded from the U.S. station before Peden applied to go in 1970. The U.S. Navy was in charge of the research station and was responsible for transportation to and from the area, plus any travel within Antarctica, and the Navy argued that the weather was too harsh and the living quarters inadequate for women. Even when Peden received a grant from the National Science Foundation (NSF) for research on Antarctic ice, only her male graduate students could visit the site. Finally, under pressure from the NSF, the Navy approved Peden to make the trip in 1970 with the requirement that she have another female scientist accompany her. Peden described her experiences in Barbara Land's 1981 book, *The New Explorers*.

Peden later served as a Division Director at NSF and served on the Polar Research Board of the National Academy of Sciences. She was also a council member for the International Arctic Research Center in Fairbanks, Alaska.

She was elected to the National Academy of Engineering in 1993. She has received numerous awards for her research, including the Society of Women Engineers Achievement Award (1973), U.S. Army's Outstanding Civilian Service Medal (1987), and Centennial Medals from the Institute of Electrical and Electronics Engineers (1984) and the University of Colorado (1988), and was named to the Hall of Fame of the American Society for Engineering Education. She is a fellow of the Institute of Electrical and Electronics Engineers (IEEE), from whom she has received numerous honors, including the 2000 Third Millennium Medal and the 2000 Distinguished Achievement Award of the IEEE Education Society. She is a member of the American Association for the Advancement of Science, the Explorers' Club, the American Geophysical Union, the New York Academy of Science, and the Society of Women Engineers.

Further Resources

University of Washington. Faculty website. <http://www.ee.washington.edu/faculty/peden/>.

Shoemaker, Brian. 2005. "Dr. Irene Peden, 8 May 2002." Interview. Polar Oral History Program. Byrd Polar Research Center Archival Program. The Ohio State University Libraries. <http://hdl.handle.net/1811/6058>.

Peebles, Florence

1874 1956

Zoologist

Education: A.B., Goucher College, 1895; Ph.D., Bryn Mawr, 1900

Professional Experience: assistant, biology, Bryn Mawr College, 1897–1898; instructor, Goucher College, 1899–1902, associate professor, 1902–1906; lecturer, Bryn Mawr, 1913; professor, biology, Newcomb College, Tulane University, 1915–1917; associate professor, physiology, Bryn Mawr, 1917–1919; professor, biology, California Christian (Chapman) College, 1928–1942

Florence Peebles was recognized for her work on tissue regeneration in both plants and animals. Her research included the morphology of regeneration, growth and development, and the embryology of chicks. She conducted early research at Woods Hole Marine Biological Laboratory and was appointed an assistant in biology at Bryn Mawr while completing her doctorate, which she received in 1900. She also completed coursework at the Universities of Halle and Munich and post-doctoral work at the Naples Zoological Station and several European universities. She received her undergraduate degree at the Women's College of Baltimore

(Goucher College) and in 1899 was appointed as an instructor. She was promoted to associate professor in 1902. Between 1898 and 1927, she worked five times at the Naples Zoological Station, and 10 times at the Woods Hole Marine Laboratory between 1895 and 1924. Since she was recognized as an important contributor to scientific literature, she received support from fellowships for many of these research sessions. She held a position at Newcomb College in 1915, returning to Bryn Mawr in 1917. She moved to California and established a bacteriology department at California Christian College (now known as Chapman College) in 1928 and a biology department in 1935. Peebles continued teaching and research even after her formal retirement, establishing a biology laboratory at Lewis and Clark College in Portland, Oregon, in 1942. Both the lab and a science scholarship fund at Lewis and Clark are named in her honor.

Peebles received an honorary LL.D. from her alma mater, Goucher College, in 1954. She was a member of the American Association for the Advancement of Science and the American Society of Naturalists.

Pennington, Mary Engle

1872–1952

Chemist, Food Scientist

Education: certificate of proficiency, University of Pennsylvania, 1892, Ph.D., 1895

Professional Experience: fellow, botany, University of Pennsylvania, 1895–1897; fellow, physiological chemistry, Yale University, 1897–1898; researcher, University of Pennsylvania, 1898–1901; director, chemical laboratory, Women’s Medical College of Pennsylvania, 1898–1906, lecturer, 1898–1906; owner, Philadelphia Chemical Laboratory, 1901–1905; director, bacteriological laboratory, Philadelphia Health Department, 1904–1907; bacteriological chemist, Bureau of Chemistry, U.S. Department of Agriculture (USDA), 1907–1908, chief, Food Research Laboratory, 1908–1919; director, research and development, American Balsa Company, 1919–1922; consultant, 1922–1952

Mary Pennington was a chemist and authority on food refrigeration, chemico-bacteriology of milk, and the chemistry, bacteriology, and histology of fresh and frozen foods. She developed methods for preserving dairy products and standards for milk inspection that were later employed throughout the country. She conducted a series of studies that led to methods of processing, storing, and shipping food that greatly increased its quality and availability. During World War I, she

devised standards for railroad refrigerator cars that were used nationally. After several years working in various academic and government positions, she established her own consulting firm in 1922, where she specialized in food handling, storage, and transportation for the next 30 years. She did original research on frozen foods, earning her the nickname in one article of the “Ice Lady.”

Pennington faced various hurdles as a woman scientist. Although she completed the requirements for a B.S. at the University of Pennsylvania, as a woman she was given only a certificate of proficiency instead of a degree. She received her doctorate and went on to Yale for another year of study in physiological chemistry. Unable to find a regular position, she briefly operated her own laboratory for chemical analysis, the Philadelphia Chemical Laboratory. She later secured a position as a bacteriological chemist with the USDA by taking the civil service exam under the name “M. E. Pennington” and accepting the job before the officials knew she was a woman. She used the same strategy when she was made chief of the Food Research Laboratory of the USDA in 1908.

Pennington was awarded the Garvan Medal of the American Chemical Society in 1940. She was the first woman member of the American Society of Refrigerating Engineers and was the first woman elected to the American Poultry Historical Society’s Hall of Fame. She was a member of the American Association for the Advancement of Science, American Chemical Society, American Society of Biological Chemists, American Institute of Refrigeration, and Society of American Bacteriologists.

Pert, Candace Dorinda (Bebe)

b. 1946

Neurophysiologist, Pharmacologist

Education: B.A., biology, Bryn Mawr, 1970; Ph.D., pharmacology, School of Medicine, Johns Hopkins University, 1974

Professional Experience: postdoctoral research fellow, National Institutes of Health, Johns Hopkins University, 1974–1975; staff fellow, National Institute of Mental Health, 1975–1977, senior staff fellow, 1977–1978, research pharmacologist, 1978–1982, chief, Section on Brain Chemistry, 1982–1988; founder and scientific director, Peptide Design, 1987–1990; Chief Scientific Officer and Director, RAPID Pharmaceuticals, 2007–

Concurrent Positions: research professor, physiology and biophysics, Georgetown University School of Medicine, Washington, D.C.

Candace Pert is a neuroscientist and pharmacologist who is one of the world's foremost researchers on the chemistry of the brain and chemical receptors, which are the places in the body where molecules of a drug or natural chemical can be inserted, thus stimulating or inhibiting various physiological or emotional effects. As a graduate student, she was the co-discoverer, with her professor, of the brain's opiate receptors, the areas in which painkilling substances such as morphine can be inserted. Her work led to the discovery of endorphins, the naturally occurring substances manufactured in the brain that relieve pain and produce sensations of pleasure, by two Scottish scientists, who were awarded the Lasker Award in 1978. Pert's major professor at Johns Hopkins University medical school, neuroscientist Solomon Snyder, also shared the Award, but her name was omitted although she had conducted the early research and had already received her doctorate. This oversight created a controversy in the scientific world, because the Lasker Award is often an early step toward receiving the Nobel Prize.

Pert continued her work on neurotransmitters at the National Institute of Mental Health for a number of years. She examined Valium receptors in the brain and the receptors where the street drug PCP, or "angel dust," takes hold, and she also led the team that discovered peptide-T. She left the government laboratory to form her own company, Peptide Design, to encourage research on peptides, and worked there from 1987 to 1990. Pert's work on peptides and their receptors has led to a new area of research, the use of a chemical called peptide-T as a potential treatment for AIDS. She has evidence that the purified peptide-T prevents viruses from getting into cells by blocking the receptor sites on the cells, and there is also evidence that peptide-T reverses the symptoms of the disease. The first work was done in 1985, and clinical trials started in the early 1990s. She continues to investigate immune systems and the nature of HIV/AIDS as an adjunct professor of physiology at Georgetown University, and, in 2007, co-founded RAPID Pharmaceuticals.

Pert has explored the mind-body connection and the effect of brain chemicals on emotional and spiritual well-being. She wrote a book entitled *Molecules of Emotion: Why You Feel the Way You Feel* (1999), and co-authored *Everything You Need to Know to Feel Go(o)d* (2006). She also produced a guided imagery and music CD, *Psychosomatic Wellness: Healing Your Body-Mind*. She won the Arthur S. Fleming Award in 1979 for her research. She is a member of the American Society of Pharmacology and Experimental Therapeutics, American Society of Biological Chemists, and Society for Neuroscience. In 1980, Pert was the primary founder of Women in Neuroscience (WIN), a professional organization and committee of the Society for Neuroscience dedicated to assessing the status of women in the field.

Further Resources

Candace Pert, PhD. <http://www.candacepert.com/>.

Petermann, Mary Locke

1908–1975

Biochemist

Education: A.B., Smith College, 1929; Ph.D., physiological chemistry, University of Wisconsin, 1939

Professional Experience: technician, Yale University, 1929–1930; researcher, Boston Psychopathic Hospital, 1930–1934; postdoctoral researcher, physical chemistry, University of Wisconsin, 1939–1945; research chemist, Memorial Hospital, New York, 1945–1946; associate professor, biochemistry, medical school, Cornell University, 1952–1966, professor, 1966–1973

Concurrent Positions: professional assistant, Committee on Medical Research, 1942–1944; associate, Sloan-Kettering Institute for Cancer Research, 1946–1960, associate member, 1960–1963, member, 1963–1973

Mary Petermann was the first person to isolate and characterize animal ribosomes, which are the site of protein synthesis in cells. Her research included the physical chemistry of proteins, electrophoresis, plasma proteins, and ribosomes. Petermann showed an early interest in science, but was deterred from science as a career path. Undaunted, she became a chemistry major at Smith College, receiving her degree in 1929. She graduated from Smith with high honors and went on to work and conduct research at Yale and then at the Boston Psychopathic Hospital for four years investigating the acid–base balance of mentally unstable patients. In 1936, she entered the University of Wisconsin and received her doctorate in physiological chemistry in 1939. She remained at Wisconsin as a postdoctoral researcher and was the recipient of several prestigious fellowships, including a Rockefeller Foundation fellowship. In 1952, she was appointed associate professor of biochemistry at Cornell University medical school, and was the first woman promoted to full professor there in 1966.

Petermann was also a longtime member and researcher at Sloan-Kettering Institute for Cancer Research in New York City, and in 1963 became the first woman appointed a full member of the Institute. Because of her research at Sloan-Kettering, the ribosomes (previously known as “particles”) were referred to by her colleagues as “Petermann’s particles.” However, simultaneous research was

being conducted at the Rockefeller Institute by another researcher, George Palade, who received public credit as the “father of the particles.” Palade, at least, acknowledged Petermann’s work and privately gave her credit as “mother of the particles.” In addition to nearly 100 scientific papers, Petermann was the author of a book, *The Physical and Chemical Properties of Ribosomes* (1964).

Petermann received the Sloan Award in cancer research (1963) and used the money to conduct research and give lectures in Europe. She also received the Garvan Medal of the American Chemical Society (1966) and a Distinguished Service Award from the American Academy of Achievement. In 1974, she organized the Memorial Sloan-Kettering Cancer Center Association for Professional Women and served as its first president. She was elected a fellow of the New York Academy of Sciences, and was a member of the American Society of Biological Chemists, the Harvey Society, and the Biophysical Society.



American biochemist Mary Locke Petermann. She was the first person to isolate and characterize animal ribosomes, which are the site of protein synthesis in cells. (Bettmann/Corbis)

Phillips, Melba Newell

1907 2004

Physicist

Education: A.B., mathematics, Oakland City College, 1926; A.M., physics, Battle Creek College, 1928; Ph.D., physics, University of California, Berkeley, 1933

Professional Experience: high school teacher, 1926–1927; instructor, Battle Creek College, 1928–1930; research associate, University of California, Berkeley, 1933–1934, instructor, 1934–1935; research fellow, Bryn Mawr College, 1935–1936; fellow, Institute for Advanced Study, 1936–1937; instructor, physics, Connecticut College for Women, 1937–1938; instructor, Brooklyn College, 1938–1944, assistant

professor, 1944–1952; lecturer, physics, Washington University, St. Louis, 1957–1962; professor, physics, University of Chicago, 1962–1972

Concurrent Positions: lecturer, University of Minnesota, 1941–1944; member, theoretical group, radio research laboratory, Harvard University, 1944; visiting professor, State University of New York, Stony Brook, 1972–1975; visiting lecturer, University of Science and Technology, Chinese Academy of Science, Beijing, 1980

Melba Phillips was a physicist whose research included theory of complex spectra and theory of light nuclei. She began her career at Oakland City College and retired as a professor of physics at the University of Chicago. She then was an instructor at Battle Creek College for three years after receiving her master's degree from that institution. She worked as an instructor at Berkeley after receiving her doctorate in 1933. Jobs were difficult to find during the Depression, but she was appointed an instructor at Connecticut College for Women for two years. She then moved to Brooklyn College in 1938, was promoted to assistant professor in 1944, and helped found the Federation of American Scientists in 1945.

At Berkeley, Phillips had worked under the direction of J. Robert Oppenheimer, who later became head of the Manhattan Project on development of the atomic bomb. In the 1930s, they had identified “the Oppenheimer-Phillips effect” to explain the behavior of the nuclei of radioactive hydrogen atoms. Despite her accomplishments of nearly 15 years at Brooklyn College, she was fired in 1952 for refusing to testify about the Manhattan Project before the McCarthy-era U.S. Senate subcommittee on internal security. Brooklyn College later publicly apologized to Phillips, but by then she had retired from the University of Chicago, where she had spent 10 years as a professor. She co-authored two textbooks: *Principles of Physical Science* (1957) and *Classical Electricity and Magnetism* (1955; rev. ed., 2005). After her formal retirement in 1972, she continued to teach for several years as a visiting lecturer at the State University of New York, Stony Brook, and at the Chinese Academy of Science in Beijing.

Phillips was especially active with the American Association of Physics Teachers (AAPT) throughout her career, serving as the first female president of the AAPT (1966–1967) and later acting executive officer (1975–1977). She received numerous awards from the AAPT, including a Distinguished Service Citation (1963) and the Oersted Medal (1974), and she was the first recipient of the Melba Newell Phillips Award (1982), established in her honor. She also received the Compton Award of the American Institute of Physics (1981), an Outstanding Teaching Award in Undergraduate Physics from Vanderbilt University (1988), and the Joseph Burton Forum Award of the American Physical Society (2003). She was

a fellow of the American Physical Society and a member of the American Association for the Advancement of Science.

Further Resources

University of Chicago News Office. "Melba Phillips, Physicist, 1907–2004." <http://www-news.uchicago.edu/releases/04/041116.phillips.shtml>.

Pitelka, Dorothy Riggs

1920–1994

Zoologist

Education: B.A., zoology, University of Colorado, Boulder, 1941; Ph.D., zoology, University of California, Berkeley, 1948

Professional Experience: assistant, zoology, University of California, Berkeley, 1941–1943, 1945–1946, lecturer, 1949–1952, assistant research zoologist, 1953–1960, associate research zoologist, 1960–1966, research zoologist, 1966–1984, adjunct professor of zoology, 1971–1984

Concurrent Positions: fellow, University of Paris, 1957–1958

Dorothy Pitelka conducted research on protozoa, single-cell organisms, in order to understand other simple organisms, such as cancer-causing viruses. Her research interests included ultrastructure, function, and carcinogenesis in mammary glands; epithelial cell differentiation in cell culture; interactions of epithelium and stroma; and the ultrastructure and morphogenesis of protozoa. She was one of the early biologists (and one of the first at Berkeley) to use the new electron microscope, and in addition to her scientific papers, she published an early book, *Electron-Microscopic Structure of Protozoa*, in 1963. She isolated and studied mammary-gland cells at the University of California, Berkeley's Cancer Research Laboratory and was one of the first researchers to identify congenitally transmitted tumor viruses. She served on the editorial boards of the *Journal of Protozoology*, *Journal of Morphology*, and *Transactions of the American Microscopical Society*.

Pitelka was born in Turkey. Her family moved to the United States when she was a young child and settled in Colorado, where she completed her undergraduate degree in zoology at the University of Colorado. She went on to receive a Ph.D. in zoology from the University of California, Berkeley in 1948, and spent the remainder of her career at Berkeley. At Berkeley, she met and married her

husband, also working on a Ph.D. in zoology. She spent her entire career at Berkeley, first as a research fellow and lecturer in zoology before being promoted through the ranks as a research scientist. She was supervisor of the electron microscope and also taught as an adjunct professor before retiring in 1984. In the 1950s, she spent a year conducting research in Paris as a fellow of the U.S. Public Health Service's National Cancer Institute.

Pitelka was elected the first woman president of the Society of Protozoologists (1964–1967). She was a member of the American Association for the Advancement of Science, the American Society for Cell Biology, the American Association of Cancer Research, and the Tissue Culture Association. She was also elected an honorary member of the Societe Francaise des Protistologues.

Further Resources

University of California. "Dorothy Riggs Pitelka, Zoology, Berkeley: 1920–1994." <http://content.cdlib.org/xtf/view?docId=hb5g50061q&doc.view=frames&chunk.id=div00079&toc.depth=1&toc.id=>

Pittman, Margaret

1901–1995

Bacteriologist

Education: A.B., Hendrix College, Arkansas, 1923; M.S., University of Chicago, 1926, Ph.D., bacteriology, 1929

Professional Experience: principal and instructor, Galloway Woman's College, 1923–1925; fellow, Influenza Commission, Metropolitan Life Insurance Company, 1926–1928; research assistant, Rockefeller Institute for Medical Research, 1928–1934; assistant bacteriologist, New York State Department of Health, 1934–1936; associate bacteriologist, National Institutes of Health (NIH), U.S. Public Health Service, 1936–1941, bacteriologist, 1941–1947, senior bacteriologist, 1948–1954, principal bacteriologist, 1954–1958, chief, Laboratory of Bacterial Products, Division of Biological Standards, 1958–1971, guest scientist, 1971–1972; guest scientist and consultant, Center for Biological Evaluation and Research, Food and Drug Administration, 1972–1975

Concurrent Positions: consultant, World Health Organization, 1958–1959, 1962, 1969, 1971–1973; U.S. Pharmacopeia Panels, 1966–1975; guest lecturer, Howard University, 1967–1970

Margaret Pittman was known for her work standardizing the pertussis vaccine for whooping cough and for her international involvement in standardizing other vaccines, such as cholera and typhoid. Her work led to a dramatic decrease in whooping cough mortality by the 1950s. After several teaching and research positions that earned her renown as a bacteriologist, she joined the NIH/U.S. Public Health Service in 1936, where she had a long career, advancing quickly through the ranks to chief of the laboratory of bacterial products in 1958. After her official retirement from the NIH in 1971, she continued to consult and work for the Food and Drug Administration. She was a consultant for the World Health Organization numerous times and was active on the U.S. Pharmacopeia Panels.

Pittman grew up in rural Arkansas, where she and her sister assisted their father, a doctor, in his practice. She went on to study biology and mathematics at Hendrix College. She taught science and Spanish at Galloway Women's College in Searcy, Arkansas, and became principal of the school as well. She was saving her money to attend medical school, but decided to pursue graduate study in bacteriology at the University of Chicago, where she received a research fellowship to pay for her studies. She earned both a master's and a doctorate in bacteriology at Chicago, focusing on the bacterium responsible for pneumonia. She moved to New York, where she spent several years as a research scientist at the Rockefeller Institute for Medical Research studying bacterium responsible for childhood meningitis. During the Depression, she was lucky to continue her work with the New York State Department of Health before joining the NIH, where in 1958 she was named the first female laboratory chief. The NIH later named the Margaret Pittman Lectureship series in her honor.

Pittman received numerous awards and honors, such as the Superior Service Award (1963) and Distinguished Service Award from the U.S. Department of Health, Education, and Welfare (1968), the Federal Woman's Award (1970), and the Alice Evans Award from the American Society for Microbiology (1990). She also received an honorary doctorate from her alma mater, Hendrix College. She has been a member of the American Association for the Advancement of Science, the American Academy of Microbiology, the Society for Experimental Biology and Medicine, and the International Association of Biological Standardization.

Pool, Judith Graham

1919 1975

Physiologist

Education: B.S., biochemistry, University of Chicago, 1939, Ph.D., physiology, 1946

Professional Experience: assistant, physiology, University of Chicago, 1940–1942; instructor, physics, Hobart and William Smith Colleges, 1943–1945; assistant, physiology and pharmacology, toxicity laboratory, University of Chicago, 1946; research associate, Stanford Research Institute, 1950–1953; research fellow, Stanford University Medical Center, 1953–1956, research associate, 1957–1960, senior research associate, 1960–1970, senior scientist, 1970–1972, professor, medicine, 1972–1975

Concurrent Positions: Fulbright research scholar, Norway, 1958–1959

Judith Pool was renowned for her work in blood coagulation, which resulted in major contributions to the treatment of hemophilia. She developed the method of isolating the anti-hemophilic factor (AHF) in blood plasma that can be removed and frozen for later use, a method that is used for transfusions to correct bleeding in hemophiliac patients and improve their quality of life. This process, called *cryoprecipitation*, has since become the standard. She did not receive credit, however, for her participation as a graduate student in the development of a microelectrode to determine the electrical potential of a muscle fiber, later referred to as the *Ling-Gerard electrode*. (Another woman medical researcher, **Ida Hyde**, had also made early discoveries in this area.)

Pool became interested in science in high school and studied biochemistry as an undergraduate at the University of Chicago. She worked as a research assistant before following her husband, a political science professor, to Hobart and William Smith Colleges in New York, where she taught physics. She returned to Chicago to complete requirements for her doctorate in physiology, which she received in 1946. She held temporary teaching and research positions before moving to the Stanford Research Institute as a research associate in 1950. She then became a fellow in the school of medicine at Stanford University, where she switched from muscle physiology to research on blood. She was senior scientist before being promoted to full professor of medicine in 1972, just three years prior to her death.

Among her numerous honors, the National Hemophilia Foundation established a Judith Graham Pool Postdoctoral Research Fellowship in her name. She received the Murray Thelin Award of the National Hemophilia Foundation (1968), the Elizabeth Blackwell Award of Hobart and William Smith Colleges (1973), and a Professional Achievement Award from the University of Chicago (1975). She was president of the Association for Women in Science in 1971, and was a member of the American Association for the Advancement of Science, American Physiological Society, and Society for Experimental Biology and Medicine, and chair of Professional Women of Stanford University Medical Center.

Poole, Joyce

b. 1956

Wildlife Biologist

Education: B.A., biological sciences, Smith College, 1979; Ph.D., animal behavior, Cambridge University, 1983

Professional Experience: researcher, Amboseli Elephant Research Project, 1974–1990; coordinator, elephant conservation and management, Kenya Wildlife Service, 1990–1994; consultant and independent researcher, 1994–2000; founder and director, ElephantVoices, 2000–

Concurrent Positions: research director, Amboseli Elephant Research Project, 2002–2007

Joyce Poole is one of the world's authorities on the African elephant. Along with her colleague, **Cynthia Moss**, she has made several significant contributions to our knowledge of elephants. In particular, she and Moss were the first to recognize that male African elephants experience *musth*—an aggressive period of increased sexual activity—just as Asian elephants do. Poole is also credited for her research on vocalization among elephants and the discovery that elephants communicate in sound ranges that are below what the human ear is able to detect. She spearheaded the campaign against ivory poaching by providing counts and identification of individual elephants to the African Wildlife Fund and World Wildlife Fund, which led to African elephants being placed on the endangered species list in 1989.

Poole has lived in Africa most of her life. Her family first moved there in 1962 when her father was appointed director of the Peace Corps program in Malawi when she was six years old. After a brief return to the United States, the family moved in 1965 to Kenya for four years. Poole decided on biology as a career path after hearing primatologist Jane Goodall speak at the National Museum of Kenya about her research. Poole took a year off from her studies at Smith College when her father accepted a job in Nairobi with the African Wildlife Leadership Foundation. During this time she held an unpaid position with Cynthia Moss at the Amboseli Elephant Research Project. Poole helped compile vast records on all of the individual elephants in the preserve, identifying them through photographs of their ears and tusks. Poole returned to Smith the following year, but spent each summer and some of the Christmas holidays at Amboseli. Since she was concentrating on identifying the male elephants, she took note of their aggressive behavior during mating and identified it as *musth*, previously thought to be found only in Asian elephants. Poole used some of the early data for an undergraduate thesis at Smith and later expanded the data for her doctoral work at Cambridge University. During

a postdoctoral fellowship at Princeton, Poole gained access to infrared sound equipment used to study whale vocalizations, and applied the technology to the study of elephant sounds.

Once she earned her doctorate, Poole decided to leave Moss's group and became elephant coordinator of the Kenya Wildlife Service with Richard Leakey; she resigned in protest when Leakey was fired in 1994, but continued her work as an independent elephant researcher. In 2000, she co-founded (with husband Petter Granli) the Savanna Elephant Vocalization Project, now known as ElephantVoices. In 2004, Poole left Africa after more than 30 years and set up headquarters for ElephantVoices in Norway. Her work has been profiled in documentaries and in wildlife and conservation magazines, such as *National Geographic* and *Smithsonian*, and she published an autobiography, *Coming of Age with Elephants* (1996). She has published numerous scientific papers and book chapters on the African elephants, and is a member of various advisory boards, including the Captive Elephant Management Coalition, Species Survival Network, and Amboseli Trust for Elephants, still run by her colleague, Cynthia Moss.

Further Resources

ElephantVoices. <http://www.elephantvoices.org/>.

Pour-El, Marian Boykan

1928–2009

Mathematician, Computer Scientist

Education: B.A., physics, Hunter College, 1949; M.A., mathematics, Harvard University, 1951, Ph.D., mathematical logic, 1958

Professional Experience: assistant professor, mathematics, Pennsylvania State University, 1958–1962, associate professor, 1962–1964; associate professor, mathematics, University of Minnesota, 1964–1968, professor, 1968–2000

Concurrent Positions: visiting faculty member, Institute for Advanced Study, Princeton, New Jersey, 1962–1964

Marian Pour-El was a mathematician who pioneered investigations on the interface among mathematical logic, mathematical analysis, computer science, and physics. Among the topics she studied in her research are the computability or noncomputability of the propagation of waves, the diffusion of heat, eigenvalues, and eigenvectors. She studied physics as an undergraduate at Hunter College in

New York and went on to graduate study at Harvard University. At Harvard in the 1950s, it was still unusual for a woman to prepare for a career as a mathematician or scientist. She recalled her first day in class at Harvard, when she was surrounded by empty chairs, as none of the other students, all men, would sit within two or three places of her, but she was soon accepted as a fellow student. After receiving a master's degree and then doctorate in mathematical logic in 1958, she joined the faculty of Pennsylvania State University. She received tenure a few years later, and then moved to the University of Minnesota, where she spent the remainder of her career.

Her husband, a biochemist, took a position in Illinois at the time she moved to the University of Minnesota (at that time, the University of Minnesota had a strong anti-nepotism rule, so it was not possible for both husband and wife to hold faculty positions there). Pour-El commented publicly on the dynamics of a long-distance marriage as a choice in order to pursue careers, and she has been committed to encouraging women to achieve satisfying careers in mathematics and science.

Pour-El was an invited lecturer on numerous occasions at colloquia, conferences, seminars, and symposia throughout Europe and the United States, and in Japan and China. She has also co-authored, with Ian Richards, *Computability in Analysis and Physics* (1989). She was a fellow of the American Association for the Advancement of Science, and a member of the American Mathematical Society, the Mathematical Association of America, and the Association for Symbolic Logic.

Further Resources

Henrion, Claudia. 1997. *Women in Mathematics: The Addition of Difference*. Bloomington: Indiana University Press.

Pressman, Ada Irene

1927–2003

Control Systems Engineer

Education: B.S., mechanical engineering, Ohio State University, 1950; M.B.A., Golden Gate University, 1974

Professional Experience: project engineer, Bailey Meter Company, 1950–1955; project engineer, Bechtel Power Corporation, 1955–1974, chief control engineer, 1974–1979, engineering manager, 1979–1987

Ada Pressman was an authority in power-plant controls and process instrumentation, and an expert in both fossil-fuel (coal, oil, and diesel) and nuclear power

plants. She was especially known for the measures she devised to safeguard people working on the sites of nuclear power plants from the danger of radiation and to protect people living in the vicinity of the plant. She specialized in the area of shut-down systems for these plants and worked to find ways to ensure that a nuclear power plant's turbine, steam engine, and reactor work together properly and safely to generate electrical power. She contributed to the technology of emergency systems, including developing a secondary cooling system that operates from a diesel generator in the event of a primary power source loss. After working for Bailey Meter Company for a few years, Pressman accepted a position as a project engineer with Bechtel Corporation in Los Angeles, a company that manages nuclear power plants throughout the world. She advanced in responsibilities to the position of engineering manager in 1979. Before she retired in 1987, she managed 18 design teams for more than 20 power-generating plants scattered around the world.

In the 1970s, Pressman successfully campaigned to have control-systems engineering classified as a separate field with the state engineering board of California, and she was the first person to be registered in the new discipline; she was also a registered mechanical engineer in California and Arizona. She received several honors and awards, including a Distinguished Alumni Award of Ohio State University (1974), Society of Women Engineers Annual Achievement Award (1976), and E. G. Bailey Award of the Instrument Society of America (1985). She was a member of the American Nuclear Society, Instrument Society of America, and Society of Women Engineers (president, 1979–1980).

Further Resources

Hatch, Sybil E. 2006. *Changing Our World: True Stories of Women Engineers*. Reston, VA: American Society of Civil Engineers.

Prichard, Diana (Garcia)

b. 1949

Chemical Physicist

Education: L.V.N. (nursing) degree, College of San Mateo, 1969; B.S., chemistry and physics, California State University, Hayward, 1983; M.S., University of Rochester, 1985, Ph.D., chemical physics, 1988

Professional Experience: research scientist, Photo Science Research Division, Eastman Kodak Company, 1983–

Diana Prichard is a research scientist who conducts research on fundamental photographic materials for Eastman Kodak Company. She received praise for her

graduate work on the behavior of gas phases at the University of Rochester, and the inventiveness of her project brought unusual attention and recognition by the scientific community. Her graduate work involved the high-resolution infrared absorption spectrum, which basically tells how much or what type of atoms or molecules are present, and she was able to construct the first instrument ever to be able to measure van der Waals clusters, which allows scientists to predict the behavior of gases. Van der Waals clusters are weakly bound complexes that exist in a natural state but are low in number, and Prichard's work allows scientists to produce these rare clusters by experimental methods in order to study them. Her graduate publications on the subject, such as a 1988 article in the *Journal of Chemical Physics*, have been cited in more than 100 subsequent publications.

In her position at Eastman Kodak, Prichard conducts basic studies in silver halide materials for photographic systems, and such work is in stark contrast to her early education. Although her parents had themselves received little education, they knew the value of education and supported her interest in learning. She received a degree in nursing and spent several years working and raising her children, but she had always been intrigued by the creativity required to do scientific research. She enrolled in California State University, Hayward, for her undergraduate degree, and then moved to the University of Rochester for her master's and doctorate degrees.

In 1992, she served on President Clinton's Transition Cluster for Space, Science, and Technology. She is active in encouraging students to undertake science and engineering careers, and founded a program in Rochester called Partnership in Education that provides Hispanic role models in the classroom to teach science and mathematics to students with only limited English proficiency. She also co-founded the Hispanic Organization for Leadership and Advancement (HOLA) at Eastman Kodak, and she is an active member of the Society of Hispanic Professional Engineers.

Prince, Helen Walter Dodson

1905 2002

Astronomer

Education: A.B., Goucher College, 1927; A.M., University of Michigan, 1932, Ph.D., astronomy, 1934

Professional Experience: assistant statistician, State Department of Education, Maryland, 1927–1931; assistant, astronomy, University of Michigan, 1932–1933;

instructor, astronomy, Wellesley College, 1933–1937, assistant professor, 1937–1945; associate professor to professor, astronomy and mathematics, Goucher College, 1945–1950; astronomer, McMath-Hulbert Observatory, University of Michigan, 1949–1957, associate director and professor of astronomy, 1957–1976; emerita professor and researcher, 1976–1979; consultant, Applied Physics Laboratory, Johns Hopkins University, 1979–2002

Concurrent Positions: summer observer, Maria Mitchell Observatory, Nantucket, 1934 and 1935; summer research assistant, Observatoire de Paris, 1938 and 1939; staff member, Radiation Laboratory, Massachusetts Institute of Technology, 1943–1945

Helen Dodson Prince spent 50 years observing solar activity, particularly the outbreak of solar flares and their effect on space, on light, and on the Earth's magnetic field. Prince was quoted in a 1963 *Time* magazine article, advising that the United States postpone missions to the moon until after 1972, when the then-current period of solar flare activity had passed and space travel would be safer and more effective. Prince worked as a statistician for a Maryland state agency before returning to graduate school to pursue a master's degree and then doctorate in astronomy. She joined the astronomy faculty at Wellesley after receiving her master's degree.

In 1934, while on the faculty at Wellesley, she completed her Ph.D. with a thesis entitled "A Study of the Spectrum of 25 Orionis." She spent several summers conducting research on solar flares and on the sun in residence at the Maria Mitchell Observatory in New England and at the Paris Observatory. Prince (then under the name Dodson) published the results of several years of her observations in the *Astrophysical Journal* in 1940. During World War II, she worked at the MIT Radiation Laboratory on the mathematical development of radar. She also taught astronomy and math at Goucher College before joining the staff of the McMath-Hulbert Observatory at the University of Michigan, where she was appointed full professor and associate director of the observatory. She published later articles on solar flares jointly with a colleague, Ruth Hedeman, and with the founder of the McMath-Hulbert Observatory, Robert McMath. Prince co-authored a biographical memoir of McMath for the National Academy of Sciences after his death in 1962.

Prince was also a revered teacher and received an honorary degree from Goucher College in 1952. Among her awards was the Annie Jump Cannon Prize of the American Astronomical Society (1955) and a Distinguished Achievement Award from the University of Michigan (1974). After retiring from the University of Michigan in 1979, Prince remained active as an independent consultant, working with the Applied Physics Laboratory at Johns Hopkins University. She was

elected a fellow of the American Astronomical Society and held memberships in the American Association for the Advancement of Science and the American Geophysical Union. She married later in life, in her fifties, and many of her publications appeared under the name Helen Dodson

Prinz, Dianne Kasnic

1938 2002

Solar Physicist

Education: B.S., University of Pittsburgh, 1960; Ph.D., physics, Johns Hopkins University, 1967

Professional Experience: E. O. Hulbert fellow in physics and astronomy, University of Maryland, 1968–1971; research physicist, Space Science Division, U.S. Naval Research Laboratory, Washington, D.C., 1967–1968 and 1971–2001

Concurrent Positions: payload specialist, National Aeronautics and Space Administration (NASA), 1985

Dianne Prinz was known for her expertise in solar-terrestrial physics, and was a specialist in designing optical instrumentation. Her research includes infrared spectroscopy of atmospheric gases and ultraviolet spectroscopy of solar and atmospheric gases. She conducted research for 30 years at the U.S. Naval Research Laboratory, beginning in 1967, taking time in the 1980s for a special assignment with NASA as a payload specialist on Spacelab-2. She began NASA training in 1978 and was finally called up on the Spacelab-2 mission in 1985 as a liaison between the experimenters and NASA, defining page displays as they evolved, developing the mission timeline, and working up detailed ground command paths. As a specialist in optical instrumentation, she designed the optics and the flight software for instruments aboard Spacelab-2. The *Challenger* accident of 1986 delayed subsequent shuttle missions and cut short any further opportunities for Prinz to participate in space flight.

At the Naval Research Laboratory, she headed a research team on solar radiation and developed new instruments and data analysis software for measuring ultraviolet radiation in the Earth's upper atmosphere, a field of study known as "space weather." Her team took high-resolution images of the sun, and their Solar Ultraviolet Spectral Irradiance Monitor (SUSIM) has been used on space shuttle flights as well as other NASA and government research missions.

Prinz was a member of the American Geophysical Union, American Astronomical Society, Washington Academy of Science, and National Capital Section

of the Optical Society of America (vice president, 1976). She received the Navy Award of Merit for Group Achievement (1985), the NASA Public Service Group Achievement Award (1987), and the Navy Meritorious Civilian Service Award (2001).

Further Resources

Cook, John William and Russell Alfred Howard. "Obituary: Dianne K. Prinz, 1938–2002." *Bulletin of the American Astronomical Society*. 35(5). (December 2003). <http://adsabs.harvard.edu/abs/2003BAAS...35.1469C>.

Profet, Margie

b. 1958

Biomedical Researcher, Evolutionary Biologist

Education: B.A., political philosophy, Harvard University, 1980; B.S., physics, University of California, Berkeley, 1985

Professional Experience: independent researcher and author

Margie Profet is an evolutionary biologist who has presented new theories relating to how humans adapt to their environment and, in particular, has challenged accepted theories on allergies, pregnancy sickness, and menstruation. Her own allergies to various foods and chemicals inspired her inquiries into an explanation for allergies. She published her early findings in a 1991 article entitled "The Function of Allergy: Immunological Defense against Toxins," in which she proposed that humans develop allergic reactions as a means of protecting the body from harmful toxins. She even noted that people with allergies are less likely to develop cancer than individuals without allergies, and believes that allergies are an internal warning device for the body. Another area of research was the cause of morning sickness during pregnancy; again, she theorized that the brain's ability to discern what is toxic becomes recalibrated during pregnancy so that almost any food or odor can cause an aversion. Her hypothesis is that all plants contain toxins and that pregnancy sickness is a natural defense mechanism that reduces the amount of toxins one ingests during the first trimester, the period when the embryo is particularly vulnerable to toxins that could cause birth defects. She presented her research in two books: *Protecting Your Baby-to-Be: Preventing Birth Defects in the First Trimester* (1995) and *Pregnancy Sickness: Using Your Body's Natural Defenses to Protect Your Baby-to-Be* (1997).

Profet next turned to an investigation into why women menstruate, and she presented the theory that sperm carry pathogens into the uterus, and that the menstrual

flow allows the uterus to rid itself of bacteria and infection. Rather than being merely a monthly waste of blood and energy, Profet theorized that the myriad bacteria found in and around the genitals of both men and women hitch rides on sperm, thus gaining access to the uterus and fallopian tubes, and that menstruation in fact washes away the contaminants that could cause infection or infertility. She published her controversial theory in the September 1993 issue of *Quarterly Review of Biology* as, “Menstruation as a Defense against Pathogens Transported by Sperm.”

Profet received two undergraduate degrees (in political philosophy and physics), but was not interested in the constraints of university research. Without an advanced degree or faculty position, she embarked upon a career as an independent researcher and evolutionary biologist, supporting herself with grants and various laboratory affiliations. Her article on menstruation led to a prestigious five-year MacArthur “genius” fellowship in 1993. In 2005, Profet disappeared while working at Harvard University and has not been seen since.

Further Resources

Martin, Mike. 2009. “Margie Profet’s Unfinished Symphony: A Promising Scientist Vanishes Without a Trace.” *Weekly Scientist*. (29 June 2009). <http://weeklyscentist.blogspot.com/2009/07/margie-profets-unfinished-symphony.html>.



Quimby, Edith Hinkley

1891 1982

Radiological Physicist

Education: B.S., Whitman College, 1912; M.A., physics, University of California, Berkeley, 1916

Professional Experience: high school teacher, 1912–1914; assistant, physics, University of California, 1914–1915; assistant to associate physicist, New York City Memorial Hospital for Cancer and Allied Diseases, 1919–1942; assistant professor, radiology, Medical College, Cornell University, 1941–1942; associate professor, radiological physics, College of Physicians and Surgeons, Columbia University, 1942–1954, professor, 1954–1960

Edith Quimby was a pioneer in the new fields of radiology and nuclear medicine in the first half of the twentieth century. Her research helped physicians in the use of x-rays for diagnostic purposes and determining safe levels of radiation therapy for the treatment of cancer and other tumors. When she started working at Memorial Hospital in 1919, commercial radium had been in production in the United States for only six years. She was one of the scientists who brought the field to maturity; between 1920 and 1940, she published more than 50 papers describing the results of her research. She not only prepared data on radiation hazards and radiation safety, but also developed training courses in medical physics. She attended Whitman College in Walla Walla, Washington, on a full scholarship to study physics and mathematics. She taught high school for two years after graduating from college and then returned to the University of California, Berkeley on a physics scholarship, receiving her master's degree in 1916. At Berkeley, she met and married fellow physics student Shirley L. Quimby, who went on to teach at Columbia University. Edith followed her husband to New York, accepting a position as an assistant physicist at the new Memorial Hospital for Cancer and Allied Diseases, where she began her career in the medical use of x-rays and radiation. She was promoted to associate physicist in 1932, but she accepted a position as associate professor of radiological physics at Columbia's medical college in 1942. She was promoted to full professor in 1954 and retired in 1960.

At Columbia, Quimby helped found the Radiological Research Laboratory, where she researched radiation therapy for thyroid disease, brain tumors, and other diseases. Not surprisingly, her research into radioactive isotopes had implications for the U.S. government's World War II-era interest in the development of a nuclear bomb, and Quimby was involved in the Manhattan Project and worked as a consultant for the Atomic Energy Commission. She was also head of the National Council on Radiation Protection and Measurements. Over the course of her long career, Quimby published her findings in numerous scientific journals and was the author or co-author of three books: *Radioactive Isotopes in Clinical Practice* (1958), *Safe Handling of Radioactive Isotopes in Medical Practice* (1960), and *Physical Foundations of Radiology* (1970).

Quimby received honorary science doctorates from her alma mater, Whitman College (1940), and from Rutgers University (1957). She was the first woman (and still one of the few) to receive the Janeway Medal of the American Radium Society (1940), and was also the recipient of the Gold Medal of the Radiological Society of North America (1941), an Achievement Medal from the International Women's Exposition of Arts and Industries (1947), the Medal of the American Cancer Society (1957), the Gold Medal of the Inter-American College of Radiology (1958), and the Gold Medal of the American College of Radiology (1963). She was a fellow of the American Physical Society and of the American College of Radiology, and was a member of the American Roentgen Ray Society and the American Radium Society (vice president, 1929; president, 1954).

R

Ramaley, Judith (Aitken)

b. 1941

Endocrinologist, Reproductive Biologist

Education: B.A., Swarthmore College, 1963; Ph.D., anatomy, University of California, Los Angeles, 1966

Professional Experience: postdoctoral fellow, anatomy and physiology, Indiana University, 1967–1968, assistant professor, 1969–1972; assistant to associate professor, physiology and biophysics, University of Nebraska Medical Center, 1972–1978, professor, 1978–1982, assistant vice president for academic affairs, 1981–1982; vice president of academic affairs, State University of New York, Albany, 1982–1984, acting president, 1984–1985, executive vice president of academic affairs, 1985–1987; executive vice chancellor, University of Kansas, 1987–1990; acting president, State University of New York, Albany, 1990; president and professor, biology, Portland State University, Oregon, 1990–1997; president and professor, biology, University of Vermont, 1997–2001; assistant director, Education and Human Resources Directorate, National Science Foundation, 2001–2004; president, Winona State University, Minnesota, 2005–

Judith Ramaley is an endocrinologist whose specialty is the physiology of puberty and the control of male and female fertility. She has been prominent both in academic research and in administration, having now served as president or acting president of four major state universities. In addition to numerous scientific publications, she published two early books, *Progesterone Function: Molecular and Biochemical Aspects* (1972) and *Essentials of Histology* (1974, rev. ed., 1978), and edited a volume of papers from the American Association for the Advancement of Science on *Covert Discrimination of Women in the Sciences* (1978). Ramaley has remained committed to educational opportunity and science education. In addition to her administrative roles within academia, as assistant director of the Education and Human Resources Directorate of the National Science, she worked on initiatives for leadership education in science, engineering, technology, and mathematics. She has written dozens of papers and articles on higher education reform, responsibility, and opportunity.

Ramaley has been an active participant in the communities in which she has lived, involving herself in sports leagues, historical and cultural societies, Girl Scouts, Planned Parenthood, and other women's and family resources. She has been a member of the American Association of Colleges and Universities (AACU) board of directors in 1995, board member of the American Association of Higher Education, member of the National School-to-Work Advisory Board, member of the Advisory Council for the National Institute on Alcohol Abuse and Alcoholism, and fellow of the Margaret Chase Smith Center for Public Policy. In 2005, she was a visiting senior scientist at the National Academy of Sciences.

Ramaley is a fellow of the American Association for the Advancement of Science and a member of the American Association of Anatomists, Endocrine Society, Society for the Study of Reproduction, Society for Neuroscience, and American Physiological Society.

Further Resources

Winona State University. "Office of the President." <http://www.winona.edu/president/>.

Ramey, Estelle Rosemary White

1917–2006

Endocrinologist

Education: B.S., mathematics and biology, Brooklyn College, 1937; M.S., physical chemistry, Columbia University, 1940; Ph.D., physiology, University of Chicago, 1950

Professional Experience: teaching fellow, chemistry, Queens College, New York, 1938–1941; lecturer, biochemistry, University of Tennessee, 1942–1947; postdoctoral fellow and instructor, endocrinology, University of Chicago, 1950–1954, assistant professor, physiology, 1954–1958; assistant to associate professor, school of medicine, Georgetown University, 1956–1966, professor, physiology, 1966–1987, professor, biophysics, 1980–1987

Concurrent Positions: visiting professor, Stanford University, Harvard University, Yale University

Estelle Ramey researched endocrinology metabolism chiefly in the field of adrenal function, sex hormones, and insulin action. She began her teaching career at Queens College while completing work for her master's degree, which she

received from Columbia University in 1940. She followed her husband's career to Knoxville, Tennessee, but when she first applied for a teaching job at the local university, she was told by the chairman that "he had never hired a woman, would never hire a woman, and I ought to go home and take care of my husband." After many male faculty members were called to duty in World War II, however, the same chairman called to offer her a teaching job. She stayed on at the University of Tennessee for five years. She went on to obtain her doctorate from the University of Chicago in 1950 and continued teaching there for several years as a U.S. Health Service postdoctoral fellow and then as the first female faculty member at the medical school. She accepted a position at Georgetown University medical school as assistant professor in 1956, and was promoted to associate professor in 1960 and professor in 1966. She was named professor of biophysics in 1980 and emeritus professor upon her retirement in 1987.

Ramey was committed to women's equality, in science and in society at large. Even after formally retiring, she continued to lecture, often donating her fees to women's organizations. She was a longtime member of the Association for Women in Science (AWIS) and founder of the AWIS Educational Foundation. As president of the AWIS (1972–1974), Ramey pressured the publisher of a standard medical school textbook to remove unnecessary photos of nude women from a new edition of the book. Her own research on sex hormones even had feminist implications in the 1970s, as she spoke out against people who would use "hormones" as a basis of sexism, rejecting the idea "that ovarian hormones are toxic to brain cells." She published more than 150 scientific papers or articles and was the co-author of *Electrical Studies on the Unanesthetized Brain* (1960).

Ramey was awarded numerous honorary doctorates, including one from her employer, Georgetown University (1977). Her other awards and honors include an Outstanding Alumna Award from the University of Chicago (1973), the Public Broadcasting Company Woman of Achievement Award (1984), and the National Women's Democratic Club Woman of Achievement Award (1993). In 1989, *Newsweek* magazine named her "one of 25 Americans who have made a difference." Ramey's expertise was widely sought, and she sat on the advisory boards of numerous government and medical institutions, including Planned Parenthood, the National Institutes of Health, the National Academy of Science, the Veteran's Administration for Women Veterans, and President Carter's Committee on the Status of Women. She was a member of several professional societies, including the American Physiological Society, the American Chemical Society, the Endocrine Society, the American Diabetes Association, and the American Academy of Neurology.

Further Resources

Fox, Margalit. 2006. "Estelle R. Ramey, 89, Who Used Medical Training to Rebut Sexism, Is Dead." *New York Times*. (12 September 2006). <http://www.nytimes.com/2006/09/12/obituaries/12ramey.html>.

Rand, (Marie) Gertrude

1886 1970**Psychologist**

Education: A.B., experimental psychology, Cornell University, 1908; M.A. and Ph.D., psychology, Bryn Mawr College, 1911

Professional Experience: postdoctoral research fellow, Bryn Mawr College, 1911–1913, associate, experimental and applied psychology, 1913–1927; associate professor, research in ophthalmology, Wilmer Ophthalmological Institute, Johns Hopkins University School of Medicine, 1928–1932, physiological optics, 1932–1936, associate director, Research Laboratory of Physiological Optics, 1936–1942; research associate, ophthalmology, Knapp Foundation, Columbia University College of Physicians and Surgeons, 1943–1957

Gertrude Rand was an experimental psychologist and leading researcher in the field of physiological optics. In collaboration with her husband, Clarence E. Ferree (also her dissertation director), she developed numerous ophthalmological tools, including a way to map the retina for its perceptual abilities and sensitivity to color. The Ferree-Rand perimeter became an important tool for diagnosing vision problems. She and Ferree moved to Johns Hopkins in 1928, where she taught first in the area of research ophthalmology, then physiological optics, before becoming associate director of the research laboratory of physiological optics in 1936. Besides their academic work, the couple served as consultants on a variety of industrial lighting projects, including consulting for New York City on plans for glare-free illumination of the Holland Tunnel and for the U.S. government on night vision for the military. After her husband's death in 1942, she moved to Columbia University, where she resumed her earlier work on color perception. It was at Columbia that she and two colleagues developed plates for testing color vision and color blindness, a test known as the H-H-R (or Hardy-Rand-Rittler, for the collaborators) test.

Rand was the first woman elected a fellow of the Illuminating Engineering Society (1952) and she was the recipient of a Gold Medal from the Society (1963). She was also the first woman to win the Edgar Y. Tillyer Medal of the

Optical Society of America (1959), and in 1971, one of her students, Louise Sloan, became the second woman to receive the Tillyer Medal. Rand was a member of the American Association for the Advancement of Science and the American Psychological Association.

Ranney, Helen Margaret

1920 2010

Hematologist

Education: B.A., Barnard College, 1941; M.D., Columbia University, 1947

Professional Experience: assistant professor, clinical medicine, Columbia University, 1958–1960; associate professor, medicine, Albert Einstein College of Medicine, 1960–1965, professor, 1965–1970; professor, State University of New York at Buffalo, 1970–1973; chair, Department of Medicine, University of California, San Diego, 1973–1986, professor of medicine, 1973–1990, professor emeritus

Concurrent Positions: board member, Squibb Corporation, 1975–1989; distinguished physician, Veterans Administration Medical Center, San Diego, 1986–1991; staff member and consultant, Alliance Pharmaceutical Corporation, San Diego, 1991–2010

Helen Ranney was known for her research in abnormal hematology, the study of blood. Her research involved the relationship of hemoglobin and red cell membrane in sickle-cell disease and red cell survival. For many years, she was a major force in medical education, clinical hematology, and blood-related research and training, and for more than 40 years, her work extended into disciplines and directions as diverse as biochemistry, physical chemistry, immunology, metabolism, genetics, rheology, pharmacology, and analytical technologies. She received early renown for identifying the hereditary or genetic aspect of sickle-cell anemia, a disease that affects primarily African Americans.

Ranney began her college studies at Barnard, the women's annex of Columbia University. When she applied for graduate study at Columbia's College of Physicians and Surgeons in 1941, she was denied acceptance. It was not until after World War II that more women were needed and therefore admitted to such programs, and she was able to complete her M.D. at Columbia by 1947. She had a distinguished early teaching and research career at the Albert Einstein College of Medicine, where she founded a heredity clinic and trained important hematologists, and then at the State University of New York at Buffalo. In 1973, she became chair of the Department of Medicine at the University of California, San Diego,

where there is now an endowed chair in her name. She authored a textbook, *Genetics in Hematology* (1990).

Ranney was elected to membership in the National Academy of Sciences in 1973. Among her awards are the J. M. Smith Prize of Columbia University (1955), the Dr. Martin Luther King, Jr., Medical Achievement Award (1972), Gold Medal of the College of Physicians and Surgeons (1978), and May H. Soley Research Award of the Western Society of Clinical Investigation (1987). She was a fellow of the American Association for the Advancement of Science and a member of the American Academy of Arts and Sciences, American College of Physicians, American Society of Clinical Investigation, and American Physiological Society, and was the first female president of both the American Society of Hematology (1974) and the Association of American Physicians (1984–1985). In 1979, she received an honorary doctorate from the University of Southern California.

Further Resources

Bunn, H. Franklin. "Helen Margaret Ranney: A Woman of Many Firsts." *The Hematologist*. American Society of Hematology. (1 March 2008). <http://www.hematology.org/Publications/Hematologist/2008/1296.aspx>.

National Institutes of Health. "Dr. Helen M. Ranney." Changing the Face of Medicine: Celebrating America's Women Physicians. National Library of Medicine, National Institutes of Health. http://www.nlm.nih.gov/changingthefaceofmedicine/physicians/biography_260.html.

Ratner, Sarah

1903–1999

Biochemist

Education: A.B., Cornell University, 1924; A.M., Columbia University, 1927, Ph.D., biochemistry, 1937

Professional Experience: assistant, pediatrics, Long Island College of Medicine, 1926–1930; assistant biochemist, College of Physicians and Surgeons, Columbia University, 1930–1931, teaching assistant, 1932–1934, Macy research fellow, department of biochemistry, 1937–1939, instructor, 1939–1943, associate, 1943–1946, assistant professor, 1946; assistant to associate professor, pharmacology, college of medicine, New York University, 1946–1954; associate member, division of nutrition and physiology, Public Health Research Institute of the City of New York, Inc., 1954–1957, member, division of biochemistry, 1957–1992

Concurrent Positions: Fogarty scholar in residence, National Institutes of Health, 1978–1979

Sarah Ratner was one of the leading researchers in the biochemistry of amino acids and protein metabolism. She did early work on acids and hormones excreted in urine and blood, but one of her most important discoveries was argininosuccinic acid, an indicator of a genetic defect related to neurological damage and even mental retardation. She was employed at Columbia University starting in 1930 as an assistant biochemist and advancing to assistant professor in 1946. A portion of this time was spent in completing her doctorate, which she received in 1937. Her slow advancement could be due to working during the years of the Depression, when faculty positions of any type were scarce, especially for women. She later taught pharmacology at New York University before accepting a position at the Public Health Research Institute of the City of New York in 1954, where she worked until her retirement in 1992 at the age of almost 90 years old.

Ratner served on the editorial boards of *Journal of Biological Chemistry* and *Analytical Biochemistry*. She received numerous awards, such as the Neuberger Medal (1959), the Garvan Medal of the American Chemical Society (1961), and the Freedman Award of the New York Academy of Sciences (1975). She was elected to membership in the National Academy of Sciences in 1974 and was awarded an honorary doctorate from the State University of New York, Stony Brook (1984). She was elected a fellow of the Harvey Society and of the New York Academy of Sciences. She was a member of the American Academy of Arts and Sciences, the American Society of Biological Chemists, and the American Chemical Society.

Further Resources

Bentley, Ronald. "Sarah Ratner. June 9, 1903–July 28, 1999." *Biographical Memoirs*. National Academies Press. <http://www.nap.edu/readingroom.php?book=biomems&page=sratner.html>.

Ray, (Marguerite) Dixy Lee

1914–1994

Zoologist

Education: B.A., zoology, Mills College, 1937; M.A., 1938; Ph.D., biological sciences, Stanford University, 1945

Professional Experience: public school teacher, 1939–1942; instructor, zoology, University of Washington, Seattle, 1945–1947, assistant to associate professor,

zoology, 1947–1976; Assistant Secretary of State, International Environmental and Scientific Affairs' Bureau of Oceans, U.S. Department of State, 1975; governor, Washington State, 1977–1981

Concurrent Positions: director, Pacific Science Center, Seattle, Washington, 1963–1972; visiting professor, Stanford University, 1964; chief scientist, International Indian Ocean Expedition's *Te Vega*, 1964; consultant, Argonne National Laboratory and Livermore National Laboratory, 1987–1994

Dixy Lee Ray was trained as a marine biologist and later received recognition as the first female governor of the state of Washington. Her scientific research focused on crustacean and other invertebrates. She spent 30 years teaching zoology at the University of Washington, Seattle, during which time she also served as director of the Pacific Science Center, an institution committed to encouraging public interest in and awareness of science. In the early 1960s, Ray was a chief

scientist for the International Indian Ocean Expedition, a multinational exploration of that ocean's marine environment. Ray was involved in many national and international projects in environmental science and policy issues. She was a consultant for the National Science Foundation, U.S. representative to the Organization for Economic Cooperation and Development for Science, member of the President's Task Force on Oceanography, and member and last chairperson of the U.S. Atomic Energy Commission under President Nixon. In this capacity, Ray was concerned about environmentally sound alternatives to fossil fuel, and she promoted the safety of nuclear power plants, a position that brought her into conflict with environmentalist groups. She published several articles and co-authored two books on environmentalism (both with Louis R. Guzzo): *Trashing the Planet* (1990) and *Environmental Overkill* (1994).



Marine biologist and environmental scientist Dixy Lee Ray was the only woman to chair the Atomic Energy Commission (AEC), appointed by President Richard Nixon in 1972, and, in 1976, became the first woman governor of Washington. (Washington State Archives)

Because of the nature of her work, spanning academic research to government policy to community development, she has been honored by various groups and was the recipient of several honorary degrees. A small selection of Ray's impressive awards includes a Guggenheim fellowship (1952), Foreign Fellow Award of the Danish Royal Society of Natural History (1965), Axel-Axelson Johnson Award from the Swedish Royal Academy of Science and Engineering (1974), Achievement Award of the American Association of University Women (1975), Abram Sacher Award from Brandeis University (1976), Walter H. Zinn Award of the American Nuclear Society (1977), Washington Award of the Western Society of Engineers (1978), Centennial Medallion Award of the American Society of Mechanical Engineers (1980), Outstanding Woman in Energy Award from Nuclear Energy Women (1981), Centennial Medal from the Institute of Electrical Engineers (1984), Woman of Achievement in Energy Award (1988), and being named among the One Hundred Honored Citizens at the State of Washington Centennial (1989). She appeared on the cover of *Time* magazine (December 12, 1977) and, in 1998, the American Society of Mechanical Engineers (ASME) established an annual Dixy Lee Ray Award for contributions to the field of environmental protection.

Further Resources

Pace, Eric. "Dixy Lee Ray, 79, Ex-Governor; Led Atomic Energy Commission." *New York Times*. (3 January 1994). <http://www.nytimes.com/1994/01/03/obituaries/dixy-lee-ray-79-ex-governor-led-atomic-energy-commission.html>.

Rees, Mina Spiegel

1902–1997

Mathematician

Education: A.B., Hunter College, 1923; A.M., Columbia University, 1925; Ph.D., mathematics, University of Chicago, 1931

Professional Experience: teacher, Hunter College High School, 1923–1926; instructor, mathematics, Hunter College, 1926–1932, assistant to associate professor, 1932–1943; principal technical aide, Applied Mathematics Panel, National Defense Research Committee, Office of Scientific Research and Development, 1943–1946; head, mathematics division, Office of Naval Research, 1946–1949, director, mathematics science division, 1950–1952, deputy science director, 1952–1953; professor, mathematics, and dean of faculty, Hunter College, 1953–1961; dean of graduate studies, City University of New York



Mathematician Mina Rees was the first woman president of the American Association for the Advancement of Science in 1971. (Bettmann/Corbis)

(CUNY), 1961–1968, provost, graduate studies, president, CUNY Graduate School and University Center, 1969–1972

Mina Rees was a researcher of linear algebra, numerical analysis, and the history of computers, and helped set up programs for government support of mathematical research. She was employed by Hunter College for 35 years, starting as an instructor in mathematics in 1926 and rising through the ranks to full professor and then dean of faculty in the 1950s. During World War II, she took a leave from Hunter to work for the Applied Mathematics Panel of the Office of Scientific Research and Development (OSRD). She worked on military applications for jet rocket propulsion and high-speed com-

puters, receiving certificates and medals of service from both the U.S. and British governments. After the war, she established the program in mathematics at the Office of Naval Research (ONR) and was the deputy science director there from 1952 to 1953. When the National Science Foundation was established in 1950, her ONR program for connecting government with academia was used as the model for government funding of mathematical and computer research. In 1953, she returned to Hunter College as professor and dean of faculty, then moved to CUNY as dean of graduate studies in 1961. She became founding president of the CUNY graduate school, where, in 1985, the Mina Rees Library was named in her honor.

Rees received many honorary degrees, honors, and awards. Among the latter were the President's Certificate of Merit (1958) and the first Award for Distinguished Service to Mathematics of the Mathematical Association of America (1962). She was the first female president of the American Association for the Advancement of Science (1971) and was a fellow of both the American Association for the Advancement of Science and the New York Academy of Sciences. She received honorary membership in the National Academy Sciences (NAS) when she was awarded the NAS Public Welfare Medal (1983). She was a member

of the American Mathematical Society, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics.

Further Resources

Williams, Kathleen Broome. 2001. *Improbable Warriors: Women Scientists and the US Navy in World War II*. Annapolis, MD: Naval Institute Press.

Reichard, Gladys Amanda

1893 1955

Anthropologist

Education: A.B., Swarthmore College, 1919; A.M., Columbia University, 1920, Ph.D., anthropology, 1925

Professional Experience: school teacher, 1909–1915; instructor, anthropology, Barnard College, 1923–1928, assistant to associate professor, 1928–1951, professor, 1951–1955

Concurrent Positions: Guggenheim fellow, Hamburg, Germany, 1926–1927

Gladys Reichard was an anthropologist known for her expertise in Navajo language and culture, but she studied other tribes. She spent her entire career at Barnard College, which for many years was the only anthropology department in a women's college in the United States. Starting about 1923, Reichard spent summers each year on Southwestern reservations learning languages, learning to weave, and observing daily life by living with families from time to time. Much of her work was financially supported by another female anthropologist, **Elsie Clews Parsons**. In 1934, Reichard made the first attempt to teach native speakers to write the Navajo language. Since Navajo society traditionally is matriarchal, women anthropologists were more successful than men in working with these tribes, and much of Reichard's work was focused on women's roles and contributions to native society. In addition to scientific articles, she published a number of books, including *Social Life of the Navajo Indians* (1928), which traced Navajo genealogy back several generations. She also published on textile production and designs, as well as books on *Navajo Religion: A Study of Symbolism* (1950), and *Navajo Grammar* (1951). The latter book on Navajo language was controversial in that she did not accept a method of transcription that was newer than the one she developed.

Reichard was a member of the American Ethnological Society (secretary, 1924–1926), the American Folklore Society (secretary, 1924–1935), and the American Association for the Advancement of Science.

Further Resources

University of South Florida. “Gladys Amanda Reichard (1893–1955).” Celebrating Women Anthropologists. <http://anthropology.usf.edu/women/reichard/reichard.html>.

Lavender, Catherine J. 2006. *Scientists and Storytellers: Feminist Anthropologists and the Construction of the American Southwest*. Albuquerque: University of New Mexico Press.

Reichmanis, Elsa

b. 1953

Computer Scientist, Organic Chemist

Education: B.S., chemistry, Syracuse University, 1972, Ph.D., organic chemistry, 1975

Professional Experience: intern, organic chemistry, Syracuse University, 1975–1976, Chaim Weizmann fellow of scientific research, 1976–1978; technical staff, organic chemistry, AT&T Bell Laboratories, 1978–1984, technical manager, Radiation Sensitive Material and Applications, 1984–1994, director, Polymer and Organic Materials Research, 1994–

Elsa Reichmanis is known for her contributions to the science of manufacturing integrated circuits, or computer chips, specifically her research centers on developing sophisticated chemical processes and materials for computer chips. She holds 11 patents, some of which are for the design and development of organic polymers, called *resists*, which are used in microlithography (the principal process by which circuits, or electrical pathways, are imprinted upon the tiny silicon chips used in computers). During the multistage process of chip manufacture, layers of resist material are applied to a silicon base and exposed to patterns of ultraviolet light. As portions of the resists harden, they become templates for the application of subsequent layers of positively and negatively charged semiconductors that serve as the channel through which electric current travels. As computer products have become smaller and smaller, it has become more and more of a challenge to develop materials and processes to manufacture them.

In addition to publishing more than 100 scientific papers, Reichmanis has edited four volumes for the American Chemical Society (ACS): *The Effects of*

Radiation on High-Technology Polymers (1989), *Polymers in Microlithography: Materials and Processes* (1989), *Irradiation of Polymeric Materials: Processes, Mechanisms, and Applications* (1993), and *Microelectronics Technology: Polymers for Advanced Imaging and Packaging* (1995). She also edited a volume of the proceedings of an International Society for Optical Engineering symposium, *Advances in Resist Technology and Processing VI* (1989).

Reichmanis was elected to membership in the National Academy of Engineering in 1995. She is a fellow of the Society of Women Engineers (SWE) and a member of the ACS (president, 2003), American Association for the Advancement of Science, Materials Research Society, and Society of Photo-Optical Instrumentation. She has received several awards, including *Research and Development Magazine's* R&D 100 Award for one of the 100 most significant inventions of 1992, SWE Annual Achievement Award (1993), American Society for Metals (ASM) Engineering Materials Achievement Award (1996), Photopolymer Science and Technology Award (1998), ACS Award in Applied Polymer Science (1999), and Perkin Medal (2001). She was a member of the Committee to Survey Materials Research Opportunities and Needs for the Electronics Industry of the National Research Council and the Air Force Science Advisory Board.

Further Resources

Bell Laboratories, Physical Sciences Research. "Elsa Reichmanis." <http://www.bell-labs.com/org/physicalsciences/profiles/reichmanis.html>.

Reinisch, June Machover

b. 1943

Psychologist

Education: B.S., New York University, 1966, M.A., Columbia University Teachers College, 1970, Ph.D., psychology, Columbia University, 1976; diplomate, American Board of Sexology, 1989

Professional Experience: instructor, psychology, Columbia University Teachers College, 1972, 1974–1975; staff research associate, psychiatry, University of California, Los Angeles School of Medicine, 1973–1974; assistant to associate professor, psychology, Rutgers University, 1975–1982; professor, psychology and psychiatry, Indiana University, 1982–1993; director and professor, Kinsey Institute for Research in Sex, Gender, and Reproduction, 1982–1993, director and professor emeritus, senior research fellow, and trustee, 1993–



Psychologist June Reinisch was the director of the Kinsey Institute for Research in Sex, Gender, and Reproduction from 1982–1993. (Douglas Kirkland/Corbis)

Concurrent Positions: adjunct assistant professor, psychiatry, College of Medicine and Dentistry of New Jersey, Rutgers University Medical School, 1976–1981, adjunct associate professor, psychiatry, 1981–1982

June Reinisch is a developmental psychobiologist who served as director of one of the most controversial social science institutes in the United States, the Kinsey Institute for Research in Sex, Gender, and Reproduction at Indiana University. Founder Alfred Kinsey's books, *Sexual Behavior in the Human Male* (1948) and *Sexual Behavior in the Human Female* (1953), helped demystify sex and make public discussion acceptable. The Kinsey Institute is an independent corporation and, during Reinisch's 11-year tenure as director, federal and private research grant funding increased tenfold; the library, archives, art col-

lections, and research and administrative spaces were expanded, modernized, and renovated; the Institute's research became multidisciplinary in focus; and a public education program was instituted. A series of international multidisciplinary conferences led to the publication of four scholarly volumes on sex differences, adolescence and puberty, sexual orientation, and AIDS and sexuality, and "The Kinsey Report" regular column was published to inform the public of Institute research.

Increased public awareness brought increased criticism, and Reinisch defended the Institute from attacks by conservative political and religious forces as well as from academic critics. In the late 1980s, a university committee issued an unfavorable review of Reinisch's programs and requested her resignation. The board of trustees, however, supported her tenure as director for five more years and, after an investigation, the president of Indiana University apologized to Reinisch and publicly supported the accomplishments of her directorship. She retired in 1993 with the titles of Director Emerita and Senior Research Fellow.

Reinisch initially planned to be an elementary school teacher, but held a variety of jobs before returning to school to obtain a master's degree in psychology to enhance her career as a music business executive. After reading **Eleanor Maccoby's** *The Development of Sex Differences* (1966), she became fascinated by the discussion of the effects of prenatal hormones on the development of gender and sex differences, and decided to pursue advanced studies at Columbia University. She taught at Rutgers University before moving to Indiana University as professor of psychology and psychiatry, and was chosen as the third director of the Kinsey Institute in 1982. She has published scientific articles in many leading journals as well as a book, *The Kinsey Institute New Report on Sex* (1990), which was translated into several languages. The volume was based on a national survey of American sexual knowledge, and addressed the public's questions with the most current scientific information. After leaving the Institute, Reinisch continued to work as an independent consultant and researcher for a variety of organizations, including the Institute of Preventive Medicine at Copenhagen University Hospital, Denmark and the Museum of Sex in New York City.

Among Reinisch's many awards are the Morton Prince Award from the American Psychopathological Association (1976), the Dr. Richard J. Cross Award for Outstanding Contributions to the Field of Human Sexuality from Robert Wood Johnson Medical School (1991), and an Award for Contributions to Sexology of the Society for the Scientific Study of Sex (1993). She is a fellow of the American Association for the Advancement of Science, American Psychological Association, and American Psychological Society, and a member of the American Association of Sex Educators, Counselors and Therapists, International Academy of Sex Research, International Society of Psychoneuroendocrinology, International Society for Research on Aggression, International Society for Developmental Psychobiology, World Research Network on the Sexuality of Women and Girls, Behavior Genetics Association, and Society for Research in Child Development.

Further Resources

The Kinsey Institute. <http://www.kinseyinstitute.org>.

Reskin, Barbara F.

Sociologist

Education: B.A., sociology, University of Washington, 1968, M.A., sociology, 1970, Ph.D., sociology, 1973

Professional Experience: acting assistant professor, University of California, Davis, 1971–1972; assistant professor to associate professor, sociology, Indiana University, Bloomington, 1973–1983; professor, sociology and women’s studies, University of Michigan, Ann Arbor, 1983–1985; professor, sociology, and Director of Graduate Studies, University of Illinois, Urbana-Champaign, 1985–1991; professor, sociology, Ohio State University, 1991–1997; professor, sociology, Harvard University, 1997–2002; S. Frank Miyamoto Professor of Sociology, University of Washington, Seattle, 2002–

Concurrent Positions: study director, Committee on Women’s Employment and Related Social Issues, National Research Council/National Academy of Sciences, Washington, D.C., 1981–1982; visiting scholar, Institute for Research on Women and Gender, Stanford University, summer, 1987; visiting professor, sociology, University of North Carolina, 1988, University of Notre Dame, 1997, Stockholm University, 1999, Manchester University, 1999

Barbara Reskin specializes in the sociology of work, including sexual and racial inequality in the workplace. In addition to numerous articles on topics related to affirmative action, gender and promotion, gender and management, racial segregation among female workers, and the effect of family responsibilities on women’s careers (in particular, many of her early publications, including her dissertation, focused on the professional advancement of women scientists), among the books she has authored, co-authored, or edited are *Sex Segregation in the Workplace: Trends, Explanations, Remedies* (1984), *Women’s Work, Men’s Work: Sex Segregation on the Job* (1986), *The Realities of Affirmative Action* (1998), and *Women and Men at Work* (1994, 2nd ed., 2002). Reskin has been an invited lecturer at universities and organizations in the United States and abroad, and she has consulted with corporations and on legal cases on issues related to employment discrimination. Her research has been supported by grants from academic, government, and professional organizations, including the National Science Foundation, Economic Policy Institute, Institute for Women’s Policy Research, Rockefeller Foundation, and National Institute of Mental Health.

Reskin was born in Minnesota, and her parents had ties to radical political and labor groups. Her father died when she was only seven years old, and her mother worked a series of clerical jobs to support the family. Barbara also worked a variety of clerical and manual jobs before attending Reed College. She left Reed and moved to Cleveland, Ohio, where she was introduced to the Congress on Racial Equality (CORE) during the civil rights movement of the mid-1960s. She was involved in actions such as organizing strikes, sit-ins, and a summer Freedom school. She attended a sociology night class at Case Western Reserve in Ohio, and

she went on to receive her degree in sociology from the University of Washington, Seattle in 1968. She continued on for graduate study and became active in the feminist movement as well, helping organize a Reproductive Counseling Center and co-authoring a pamphlet about birth control for college women. She received a master's degree and then a Ph.D. in 1973 with her dissertation on "Sex Differences in the Professional Life Chances of Chemists." She began her teaching career at the University of California, Davis while still a graduate student and later served on the faculty of several Midwestern universities. In 1981, she took a year off from teaching to direct a study of sex segregation in the workplace for the National Academy of Sciences (NAS) in Washington, D.C. This experience galvanized her commitment not only to feminist social science research but also to applying research to social justice policy.

Reskin was elected a fellow of the NAS in 2006 and has served on numerous NAS and National Research Council committees, including the Committee on the Education and Employment of Women in Science and Engineering (1978–1982). She is a fellow of the American Academy of Arts and Sciences and the Sociological Research Association, and has served as vice president (1990) and president (2002) of the American Sociological Association (ASA). Her numerous awards and honors include a Distinguished Scholar Award of the ASA Section on Sex and Gender (1995), an SWS Mentorship Award (1998), and a DuBois Distinguished Scholarly Career Award from the ASA (2008).

Further Resources

University of Washington. Faculty website. http://www.soc.washington.edu/people/faculty_detail.asp?UID=reskin.

American Sociological Association. "Barbara F. Reskin. President 2002." <http://www2.asanet.org/governance/reskin.html>.

Resnik, Judith A.

1949–1986

Electrical Engineer, Astronaut

Education: B.S., Carnegie Mellon University, 1970; Ph.D., electrical engineering, University of Maryland, 1977

Professional Experience: electrical engineer, RCA Corporation, 1970–1974; biomedical engineer, Laboratory of Neurophysiology, National Institutes of Health, 1974–1977; senior systems engineer, Xerox Corporation, 1977–1978; astronaut,



Electrical engineer Judith Resnik was one of the first six women selected as astronauts in 1978. (AP/Wide World Photos)

National Aeronautics and Space Administration (NASA), 1978–1986, missions STS 41-D (1984) and STS 51-L (1986)

Judith Resnik was one of the first six women to be selected as astronauts by NASA in 1978. She was the second woman in the United States to fly in space, and she was among the crew who died when the space orbiter *Challenger* exploded on January 28, 1986, just after the launch from Cape Canaveral, Florida. Earlier, in 1984, she was a member of the crew of the Earth orbiter *Discovery* and was responsible for operating the Remote Manipulator System (RMS) on that mission. The RMS is the huge robotic arm that can lift satellites out of the orbiter and bring them back again. The crew was nicknamed “Icebusters” because they were able to use

the arm to remove ice particles from the orbiter. When the RMS was first tested in space in 1981, it was another female astronaut, **Sally Ride**, who assisted from Mission Control. Although Resnik was an expert on using the shuttle arm, her initial flight assignment did not call for that specialty but instead required a great deal of photographic work. Later, when the flight was changed to include the shuttle arm, she had the opportunity to use her expertise as an electrical engineer.

Many of the male astronauts and employees of NASA were vehemently opposed to adding women to the program, but most reluctantly admitted that the women were qualified for their jobs. The first men selected had all been military test pilots because they had experience flying at high altitudes. However, in the late 1970s, the space program was shifting toward developing an orbiting space station, which required crewmembers with more scientific backgrounds, and most of the women astronauts held degrees in engineering or physics. All of the astronauts trained in multiple assignments in order to expand their capabilities to the maximum. After her death, Resnik became a hero and role model and was profiled in various news magazine and books about the women astronauts.

Further Resources

Kevles, Bettyann H. 2003. *Almost Heaven: The Story of Women in Space*. New York: Basic Books.

National Aeronautics and Space Administration. "Judith A. Resnik (Ph.D.)." <http://www.jsc.nasa.gov/Bios/htmlbios/resnik.html>.

Richardson, Jane S.

b. 1941

Biochemist

Education: B.A., philosophy, Swarthmore College, 1962; M.A., philosophy, Harvard University, 1966

Professional Experience: technical assistant, chemistry, Massachusetts Institute of Technology, 1964–1969; general physical scientist, Laboratory of Molecular Biology, National Institute of Arthritis and Metabolic Diseases, 1969; associate, anatomy, Duke University, 1970–1984, medical research associate professor, biochemistry and anatomy, 1984–1988, biochemistry, 1988–1991, James B. Duke Professor of Biochemistry, 1991–

Concurrent Positions: co-director, Molecular Graphics and Modeling Shared Resource, Duke Comprehensive Cancer Center, Duke University, 1988–

Jane Richardson is a biochemist and crystallographer who studies the three-dimensional structures of proteins, emphasizing the underlying principles of their architecture, aesthetics, interrelationships, and folding mechanism. She and her husband and collaborator, David Richardson, developed a way of mapping protein folding known as the *Richardson diagram*. Her 3-D ribbon diagrams were first published in the journal *Protein Chemistry* in 1981 and have since become the standard images for visualizing protein strands and structures. In 1985, she received a five-year MacArthur "genius" grant, and *Science Digest* chose the Richardsons' work on the first chemical synthesis of the protein betabellin as one of the year's 100 best inventions. Betabellin is a bell-shaped, beta-pleated-sheet protein whose structural properties were accurately predicted. Creating proteins that do not occur in nature can provide scientists with a better understanding of the structure of natural proteins, and the synthesis of proteins may open the way to designing hormones and drugs, and improving myriad industrial products.

Richardson had an early interest in science, and as a teenager in 1958, she won third place in the national Westinghouse Science Talent Search with her project on calculations of the satellite *Sputnik*'s orbit made from her own observations. She studied philosophy, mathematics, and physics at Swarthmore College, and went on to receive a master's degree from Harvard. Although she never earned a Ph.D. or M.D., she worked at the National Institutes of Health in the Laboratory of Molecular Biology for several years before moving to Duke University, where she advanced in rank to become the James B. Duke Professor of Biochemistry, and became co-director of a lab and of the Molecular Graphics and Modeling Shared Resource at the Duke Comprehensive Cancer Center. She has received honorary doctorates from Swarthmore and from the University of North Carolina.

Richardson was elected to membership in the National Academy of Sciences in 1991 and the Institutes of Medicine in 2006. She has been a member of the National Center for Research Resources and the National Institutes of Health, and an industrial consultant for Upjohn Company, Hoffman-LaRoche Company, Allied Chemical Corporation, Becton Dickinson, and NutraSweet. She is a member of the American Academy of Arts and Sciences, Biophysical Society, American Crystallographic Association, and Protein Society Office.

Further Resources

Duke University. "Richardson Laboratory." <http://kinemage.biochem.duke.edu/>.

Ride, Sally Kristen

b. 1951

Physicist, Astronaut

Education: B.A., English and B.S., physics, Stanford University, 1973, M.S., 1975, Ph.D., physics, 1978

Professional Experience: researcher, Department of Physics, Stanford University, 1978; trainee, National Aeronautics and Space Administration (NASA), 1978–1979, astronaut, 1979–1987, missions STS-2 (1981), STS-3 (1982), STS-7 (1983), STS 41-G (1984), special assistant, long-range and strategic planning, 1987; science fellow, Stanford University Center for International Security and Arms Control, 1987–1989; professor, physics and director, California Space Institute, University of California, San Diego, 1989–

Sally Ride was the first American woman to be sent into outer space in 1983 and the first American woman to make two space flights. Ride's first flight was in the



Sally Ride, America's first woman astronaut, communicates with ground controllers from the flight deck during the six day mission of the *Challenger* in June, 1983. (National Archives)

space shuttle *Challenger* in June 1983. Among the team's missions were deployment of international satellites and numerous research experiments supplied by a number of groups—ranging from a naval research lab to high school students. While operating the shuttle's robot arm, she handled the first satellite deployment and retrieval, the first time such an arm had been used in space during flight. Her second flight was also in the *Challenger* in October 1984. This time, the robot arm was used to readjust a radar antenna on the shuttle as well as to deploy and capture a satellite. Objectives on this mission covered scientific observations of the Earth and demonstrations of potential satellite-refueling techniques. Ride was chosen for a third scheduled flight, but it was canceled after the *Challenger* exploded in January 1986. She was the only astronaut chosen for the commission investigating the mid-launch explosion of the *Challenger*, which killed all crewmembers aboard.

Ride created NASA's Office of Exploration, and she was also the first woman astronaut to leave the space program when she quietly resigned in 1987 to join

the Stanford Center for International Security and Arms Control. She went on to become director of the California Space Institute and physics professor at the University of California, San Diego. Ride has always been committed to science education, and during her tenure at NASA, she regularly addressed students at high schools and colleges about careers in science and engineering. In 2001, she created Sally Ride Science, an organization that encourages girls to study science, and she established an interactive educational Internet site, Space.com. She has published three children's books about space: *To Space and Back* (1986), *Voyager: An Adventure to the Edge of the Solar System* (1992), and *The Third Planet: Exploring the Earth from Space* (1994).

Ride was appointed a member of the Presidential Commission of Advisors on Science and Technology in 1994, and she has received the Jefferson Award for Public Service from the American Institute for Public Service (1984) and two National Spaceflight Medals (recognizing her shuttle missions of 1983 and 1984). At the National Air and Space Museum in Washington, D.C., there is a model of Sally Ride in her space uniform honoring her as the first American woman in space.

Further Resources

Kevles, Bettyann H. 2003. *Almost Heaven: The Story of Women in Space*. New York: Basic Books.

National Aeronautics and Space Administration. "Sally K. Ride (Ph.D.)." <http://www.jsc.nasa.gov/Bios/htmlbios/ride-sk.html>.

University of California, San Diego. Faculty website. <http://cass.ucsd.edu/personal/sride.html>.

Space.com. <http://www.space.com>.

Riley, Matilda (White)

1911–2004

Sociologist

Education: B.A., Radcliffe College, 1931, M.A., sociology, 1937

Professional Experience: research assistant, Harvard University, 1932; vice president, Market Research Company of America, 1938–1949; research specialist, Rutgers University, 1950, professor, 1951–1973, director, sociology laboratory, and chair, Departments of Sociology and Anthropology, 1959–1973; professor, political economics and sociology, Bowdoin College, 1973–1981; associate director,

National Institute on Aging, Washington, D.C., 1979–1998, scientist emeritus, 1999–2004

Concurrent Positions: chief consulting economist, War Production Board, 1941–1943; summer faculty, Harvard University, 1955; visiting professor, New York University, 1956–1961; associate and director, Aging and Society, Russell Sage Foundation, 1964–1973, staff sociologist, 1974–1977; research fellow, Center for Advanced Study in the Behavioral Sciences, Palo Alto, CA, 1978–1979; senior research associate, Center for Social Sciences, Columbia University, 1978–1980

Matilda Riley was one of the foremost authorities on aging and gerontology. While *aging* refers to the psychological of mental, emotional, or physical development of a person of any chronological age, *gerontology* deals with the aging process and with issues specifically related to later life. In the February 1987 issue of *American Sociological Review*, Riley stated, “I believe that an understanding of age can clarify and specify time-honored sociological propositions, raise new research questions, demand new (as well as the old) methodological approaches, and even enhance the integrative power of our discipline (a power eroded in recent years through pluralism and disputes).” A few years later, she developed a theory about the influence exerted by the lives and experiences of sociologists on social and intellectual structure and change, both in sociology and in society as a whole. She identified examples of this influence in four areas of concern: sociological practice, gender, age, and dynamic social systems. In addition to papers published in journals, she published eight books and edited five more. She co-edited *Age and Structural Lag: Society’s Failure to Provide Meaningful Opportunities in Work, Family, and Leisure* (1994), in which the authors argued that the lack of employment opportunities for older people was both unnecessary and modifiable. As the American baby-boomer generation reaches retirement age in the early twenty-first century, Riley’s work remains especially relevant.

For much of her career, she had a professional partnership with her husband, Jack Riley, who died in 2002. Even as she approached her nineties, she remained active in her career. Instead of retiring after nearly 25 years at Rutgers University, she moved to Bowdoin College and then spent 20 years as associate director of the National Institute on Aging. Her election to membership in the National Academy of Sciences in 1994 was a long-delayed recognition of her years of research. In 1998, she was named Scientist Emeritus at the National Institutes of Health (NIH), the only social scientist ever given that distinction, and the NIH organized a 2001 lecture series in her honor entitled “Soaring: An Exploration of Science and the Life Course.”

Riley received numerous honorary degrees and awards, such as the Commonwealth Award in Sociology (1984), the Distinguished Creative Contribution to

Gerontology Award (1990) and the Kent Award (1992), both of the Gerontological Society of America, and the Radcliffe Alumnae Award (1982). She was a fellow of the Center for Advanced Study in the Behavioral Sciences and a member of the Gerontological Society of America and the American Association for the Advancement of Science. She served as executive secretary of the American Sociological Association (ASA) (1949–1960), at a time when women rarely held office in any professional associations, and eventually served a term as president of the ASA (1986). Both Rutgers University and Bowdoin College have established academic prizes in her name.

Further Resources

Abeles, Ronald P. “Soaring: Celebrating Matilda White Riley (1911–2004).” <http://www.asanet.org/footnotes/jan05/indexthree.html>.

Rissler, Jane Francina

b. 1946

Botanist

Education: B.A., Shepherd College, 1966; M.A., West Virginia University, 1968; Ph.D., plant pathology, Cornell University, 1977

Professional Experience: fellow, fungal physiology, Boyce Thompson Institute, 1977–1978; assistant professor, plant pathology and botany, University of Maryland; staff scientist, Environmental Protection Agency; National Wildlife Federation; senior staff scientist and deputy director, Agriculture and Biotechnology, Food & Environment Program, Union of Concerned Scientists, 1993–

Jane Rissler is a plant pathologist and activist who has raised public awareness about genetically modified and engineered plants. Although scientists and farmers have practiced plant breeding for centuries, in recent decades it has become possible to transfer genetic material among plants. As a plant pathologist, she is concerned about the possibility of transferring diseases from plant to plant and about the possibility of introducing diseased plants into food crops.

Rissler is a senior scientist and director of the Food & Environment Program for the Union of Concerned Scientists, which conducts and compiles scientific research for the purpose of presenting policy suggestions on issues related to agriculture, biotechnology, pesticides, and the environment. In addition to numerous papers and interviews, she has co-authored two of the books the group has published. *Perils Amidst the Promise: The Ecological Risk of Transgenic Plants in a*

Global Market (1993) was written as a scientific and ecological response to policy issues and the politics of biotechnology. That research was enlarged and revised as *The Ecological Risks of Engineered Crops* (1996), in which the authors acknowledge that applications of biotechnology in crops are already a commercial reality. Rissler and others do not oppose genetic engineering as a component of agriculture as a whole, but only wish to encourage public debate about the potential harmful consequences of transgenic plants and to suggest a risk-assessment methodology.

Rissler grew up in rural West Virginia and received her doctorate in plant pathology from Cornell University in 1977. She taught plant pathology at the University of Maryland and was a policy consultant for the Environmental Protection Agency and the National Wildlife Federation before joining the Union of Concerned Scientists. She has been an important liaison to the public, co-editing a newsletter on genetic engineering and appearing on television and radio shows such as NPR, CNN, and various news outlets. She is a member of the American Phytopathological Society.

Further Resources

“Harvest of Fear. Interviews: Jane Rissler.” PBS. (October 2000). <http://www.pbs.org/wgbh/harvest/interviews/rissler.html>.

Union of Concerned Scientists. “Experts.” <http://www.ucsusa.org/news/experts/jane-rissler.html>.

Rivlin, Alice (Mitchell)

b. 1931

Economist

Education: B.A., Bryn Mawr, 1952; M.A., Radcliffe College, 1955, Ph.D., economics, 1958

Professional Experience: teaching fellow and tutor, economics, Harvard University, 1954–1957; research fellow, Economic Studies, Brookings Institution, 1957–1958, senior staff economist, 1958–1966; Deputy Assistant Secretary for Program Coordination, U.S. Department of Health, Education, and Welfare, 1966–1968, Assistant Secretary for Planning and Evaluation, 1968–1969; senior fellow, Economic Studies, Brookings Institution, 1969–1975; director, U.S. Congressional Budget Office, 1975–1983; director, Economic Studies Program, Brookings Institution, 1983–1987, senior fellow, 1987–1992; professor, Public Policy, George

Mason University, 1992–1993; deputy director, U.S. Office of Management and Budget, 1993–1994, director, 1994–1996; vice chair, Federal Reserve Board, 1996–1999; senior fellow, Economic Studies, Brookings Institution, 1999–; co-director, Brookings-Greater Washington Research Program, 2001–2002; professor, Milano Graduate School of Management and Urban Policy, New School University, 2001–2003; director, Greater Washington Research Program, Brookings Institution, 2002–

Concurrent Positions: staff member, Advisory Commission on Intergovernmental Relations, 1961–1962; visiting professor, J. F. Kennedy School of Government, Harvard University, 1988; chair, District of Columbia Financial Assistance and Management Authority, 1998–2001; visiting professor, Public Policy Institute, Georgetown University, 2003–

Alice Rivlin is an economist who has spent at least half of her career in the federal government, beginning as a member of the staff of the U.S. Department of Health, Education, and Welfare, where she implemented a system of budgeting and programming, and brought economic analyses to bear on the agency's policy decisions. She was the first head of the Congressional Budget Office (CBO) when it



Economist Alice Rivlin has held numerous appointments with the U.S. government, including as first head of the Congressional Budget Office and vice chair of the Federal Reserve Board. (AP/Wide World Photos)

was established in 1975. In 1996, she became vice chair of the Federal Reserve Board. Rivlin would have been in a position to replace the chair of the Federal Reserve, Alan Greenspan, but she resigned in 1999, one year before his retirement. After completing her doctorate, Rivlin obtained a position as an economist with the Brookings Institution in Washington, D.C., a well-known non-profit think tank devoted to independent research, education, and publications on social issues. She has been affiliated with Brookings off and on during her career and in 2002 became the director of their Greater Washington Research Program. Under the auspices of the Brookings Institution, she has published regularly on pressing political and economic issues since the 1960s, providing an economic analysis of education policy, medical care, welfare, elder care, and balancing the budget. Her most recent publications include *Beyond the Dot Coms: The Economic Promise of the Internet* (2001) and *Restoring Fiscal Sanity: How to Balance the Budget* (2004). She has also served as a consultant to a variety of government agencies.

In 1974, Congress passed the Congressional Budget and Impoundment Control Act, which provided for a House budget committee, a Senate budget committee, and the CBO. The last was to be an independent, nonpartisan office that would work with the two congressional committees to assist the members of Congress in analyzing and forming policy on federal spending and income. The CBO was also responsible for monitoring the national economy and its impact on the federal budget, for providing budgetary statistics to Congress, and for proposing alternative budgeting policies. As director of the CBO, Rivlin found herself embroiled in controversy because some of the recommendations of the CBO stepped on the toes of powerful people in Congress who had pet projects they were promoting. Also, her analyses and recommendations often were more negative than those provided by the executive branch, a factor that annoyed a series of U.S. presidents. For example, she found herself in conflict with Ronald Reagan's supply-side economics, and she forecast a deficit for 1984 while his office insisted he would balance the budget. Although her forecast proved to be correct, she was able to keep her job because there was a sharp drop in inflation that defused the argument.

After completing her second term at the CBO, Rivlin resigned her office there and returned to teaching, research, and writing. In 1993, she returned to federal employment when President Bill Clinton appointed her the deputy director of the U.S. Office of Management and Budget, the budgeting agency for the executive branch and the agency whose data she had disagreed with while head of the CBO. She was promoted to director in 1994 but resigned in 1996 to serve as vice chair of the Federal Reserve Board. Rivlin has received numerous honors and distinctions, including an honorary law degree from Hood College (1970), the Radcliffe College Founders Award (1970), a prestigious MacArthur Foundation Fellowship

(1983–1988), and a Lifetime Achievement Award from the D.C. Chamber of Commerce (2004).

Further Resources

Brookings Institution. “Alice M. Rivlin.” <http://www.brookings.edu/scholars/arivlin.htm>.

Olson, Paulette I. and Zohren Emami, eds. 2002. *Engendering Economics: Conversations with Women Economists in the United States*. New York: Routledge.

Roberts, Edith Adelaide

1881 1977

Botanist

Education: A.B., Smith College, 1905; M.S., University of Chicago, 1911, Ph.D., plant physiology, 1915

Professional Experience: instructor to associate professor, botany, Mount Holyoke College, 1915–1917; extension worker with women, U.S. Department of Agriculture (USDA), 1917–1919; associate professor, botany, Vassar College, 1919–1921, professor, 1921–1950; consultant and guest scientist, Massachusetts Institute of Technology (MIT), 1950–retirement

Edith Roberts was recognized by her contemporaries for her research in plant physiology, ecology, germination of seeds, and propagation of native plants. She was a faculty member at Vassar College for more than 30 years and established the first outdoor ecological laboratory in the United States in Dutchess County, New York. The laboratory eventually contained more than 2,000 local native plant species, and Roberts co-authored a botanical history of Dutchess County in 1938. After completing her doctorate from the University of Chicago in 1915, she joined the faculty of Mount Holyoke for three years, then accepted a position with the USDA as an extension worker with women for three years. Sources do not mention the specific work she did for the USDA. Since this was during World War I, it is possible she was involved in gardening projects for women during wartime, when women managed farms for the men who were in service. She was appointed an associate professor of botany at Vassar College in 1919 and promoted to professor in 1921.

With gardener and landscape architect Elsa Rehmann, Roberts wrote a series of articles on plant ecology for *House Beautiful* magazine which were collected into a popular 1929 book, *American Plants for American Gardens: Plant Ecology, the Study of Plants in Relation to Their Environment*; the book was reprinted in a new edition in 1996. Roberts was also the author of *American Ferns*:

How to Know, Grow and Use Them (1935). She retired from Vassar in 1950, but went on to consult for the department of food technology at MIT, researching plant sources for vitamins. Roberts was a member of the Botanical Society of America, the American Forestry Association, and the American Association for the Advancement of Science.

Roberts, Lydia Jane

1879–1965

Nutritionist and Home Economics Educator

Education: teaching credential, Mount Pleasant Normal School (later Central Michigan University), 1909; B.S., home economics, University of Chicago, 1917, M.S., 1919, Ph.D., home economics, 1928

Professional Experience: school teacher, 1899–1915; assistant to associate professor, home economics, University of Chicago, 1919–1930, professor and department chair, 1930–1944; chair, home economics, University of Puerto Rico, 1946–1952

Lydia Roberts was a pioneer in the field of nutrition of children and had a key role in the development of government nutrition standards, such as determining the Recommended Dietary Allowances (RDA) of vitamins and minerals. She entered the University of Chicago at age 36 to begin her formal training in nutrition. She was already teaching at Chicago when received her Ph.D. in home economics in 1928; she was promoted to full professor and became department chair in 1930. At Chicago, she offered a curriculum with a strong basis in scientific research and was able to work on children's nutrition issues in a clinical setting. She conducted surveys of children's feeding and nutrition status for the U.S. Children's Bureau. Her book, *Nutrition Work with Children* (1927), was based on her dissertation research and became a classic in its field, going through several editions. It was as chair of the U.S. government's Food and Nutrition Board (FNB) that she developed the RDA guidelines based on the latest scientific research on human nutrient and vitamin needs. The first RDA report was the result of a committee of more than 40 nutrition scientists, an amazing 25 of whom were women. The findings of the FNB committee were first published by the American Dietetic Association in 1943.

After retiring from the University of Chicago, Roberts accepted a position as chair of the home economics department at the University of Puerto Rico, a position she retained until 1952. During this time she reported on nutrition on the island for the U.S. Department of Agriculture and co-authored a report, *Patterns of Living*

in *Puerto Rican Families* (1949). Even after formally retiring from the University, she remained in Puerto Rico working on issues of nutrition and economic development for a rural community and developing an experimental program that became an island-wide model.

Roberts received the Borden Award of the Home Economics Association (1938). She was a member of the Council of Foods and Nutrition of the American Medical Association and the American Association for the Advancement of Science.

Further Resources

Harper, Alfred E. 2003. "Contributions of Women Scientists in the U.S. to the Development of Recommended Dietary Allowances." *The Journal of Nutrition*. 133: 3698–3702. (November 2003). <http://jn.nutrition.org/cgi/content/full/133/11/3698>.

Robinson, Julia Bowman

1919–1985

Mathematician

Education: A.B., University of California, Berkeley, 1940, M.A., 1941, Ph.D., mathematics, 1948

Professional Experience: mathematician, Berkeley Statistical Laboratory, 1939–1945; junior mathematician, Rand Corporation, 1949–1950; lecturer, mathematics, University of California, Berkeley, 1960–1964, 1966–1967, 1969–1970, and 1975; professor, mathematics, 1976–1985

Julia Robinson was a mathematician whose research focused on number theoretical decision problems and on recursive functions. She was one of the first American women mathematicians. She showed an early interest in mathematics and was often the only girl in high school taking advanced courses in mathematics and physics. Upon her high school graduation, she received a special medal for excellence in science and math, and entered San Diego State University at the age of 16; she later transferred to and received multiple degrees from the University of California, Berkeley. She was married to a mathematics professor, Raphael M. Robinson, in December 1941, just after the Japanese attack on Pearl Harbor, and during World War II, she worked for the Berkeley Statistical Laboratory on military projects. She was discouraged at being unable to secure a faculty position at Berkeley (due to anti-nepotism rules) and being unable to have children (due to serious health problems since her own childhood), but she continued on to receive her doctorate in 1948.

She worked for the Rand Corporation for two years and then took several years off for her health, including heart surgery. Beginning in 1960, she began teaching one graduate course per quarter at Berkeley. She became interested in a list of unsolved mathematical problems posed in 1900 by German number theorist David Hilbert. Robinson set to work on solving the equation known as “Hilbert’s Tenth Problem” and published several papers on the topic. In 1970, she learned that a Russian mathematician had solved the equation based on her hypothesis. She became internationally known for this work and, in 1975, was promoted to full professor at Berkeley. Her sister, Constance Reid, collected Robinson’s autobiography as well as several articles about her work for the 1996 volume, *Julia, A Life in Mathematics*.

Robinson was the first woman mathematician elected to the National Academy of Sciences (1975), and she became the first woman elected president of the American Mathematical Society (1983). She received an honorary degree from Smith College (1979) and in 1983 was awarded a prestigious five-year MacArthur Fellowship. She also was a member of the American Academy of Arts and Sciences and the Association for Symbolic Logic.

Further Resources

Reid, Constance, ed. 1996. *Julia, A Life in Mathematics*. Washington, D.C.: Mathematical Association of America.

Agnes Scott College. “Julia Bowman Robinson.” Biographies of Women Mathematicians. <http://www.agnesscott.edu/lriddle/women/robinson.htm>.

Roemer, Elizabeth

b. 1929

Astronomer

Education: B.A., University of California, Berkeley, 1950, Ph.D., astronomy, 1955

Professional Experience: assistant astronomer, University of California, 1950–1952, laboratory technician, Lick Observatory, 1954–1955, research astronomer, 1955–1956; research associate, Yerkes Observatory, University of Chicago, 1956; astronomer, Flagstaff Station, U.S. Naval Observatory, 1957–1966, acting director, 1965; associate professor, astronomy, and member, Lunar and Planetary Laboratory, University of Arizona, Tucson, 1966–1969, professor, 1969–1998, astronomer, Steward Observatory, 1980–1998, emerita

Elizabeth Roemer is renowned as the premier recoverer of “lost” comets, that is, comets whose planned rediscovery is based on predictions from previous returns. She calls her profession “astrometry,” which is the branch of astronomy that deals with the measurement of the positions and motions of the celestial bodies. In her lifetime study of comets, she has rediscovered at least 79 returning periodic comets and visual and spectroscopic binary stars, plus computing the orbits of comets and minor planets. Her publications have covered many topics, such as comets and minor planets, astronomy and practical astronomy, computation of orbits, astrometric and astrophysical investigations of comets, minor planets and satellites, and dynamical astronomy. She is regarded by her peers as a contributor to many scientific and astronomical discoveries, and her precise photographic observations of comets have led to a great many cometary orbits of importance.

In 1965, a colleague named Asteroid 1657 “Roemera” in her honor. Although each comet and asteroid is assigned a number in an international database, not all have names; after the sightings have been verified, it is the privilege of the discoverer to name the item or to have it named in their honor. Roemer made her first major rediscoveries while she was working at the U.S. Naval Observatory at Flagstaff, Arizona, and it was at that same time that her photographic records of comets and her notes on their physical characteristics began to earn her national recognition.

She taught adult classes in the local public school system while attending school at the University of California, Berkeley. She also served as an assistant astronomer and later as a laboratory technician at the Lick Observatory. She worked briefly for the university after graduation and was also a research associate at the Yerkes Observatory of the University of Chicago. She then joined the staff of the Flagstaff Station of the U.S. Naval Observatory and later moved to the University of Arizona as an associate professor and a member of the Lunar and Planetary Laboratory before becoming a full professor of astronomy. She retired in 1998 but continues her research on comets and asteroids.

She has received numerous prizes, such as the B. A. Gould Prize of the National Academy of Sciences (1971), the Donohoe lectureship of the Astronomical Society of the Pacific (1962), the National Aeronautics and Space Administration (NASA) Special Award (1986), and the Dorothea Klumpke Roberts Prize of the Astronomical Society of the Pacific (1950) named for another American astronomer who was recognized for her work in charting and cataloging stars in the late nineteenth century. Roemer is a fellow of the American Association for the Advancement of Science and a member of the American Astronomical Society, American Geophysical Union, Astronomical Society of the Pacific, International Astronomical Union, British Astronomical Association, and Royal Astronomical Society of London.

Rolf, Ida P.

1896–1979

Biochemist, Physical Therapist

Education: B.S., Barnard, 1916; Ph.D., biological chemistry, College of Physicians and Surgeons, Columbia University, 1920

Professional Experience: associate, chemotherapy and organic chemistry, Rockefeller Institute, 1920–1928; independent practitioner and physical therapist, 1930–1979; founder, Rolf Institute of Structural Integration, Boulder, Colorado, 1971–1979

Ida Rolf was a biochemist and physical therapist who created a unique and controversial treatment of “structural integration,” also termed “Rolfing.” Her method is a vigorous program of physical manipulations to release anger and tensions, and to restore the free flow of fluids, nerve impulses, and energy through the body. It was based on the belief that the body is plastic and not a fixed unit, as medical science would hold. A key feature of the treatment is that the structure, particularly the alignment, of the body would often be changed, and the patient might look much different because he or she was standing, moving, and walking in a new way. Some sources attribute Rolf’s interest in physical therapy and natural medicine to a condition suffered by one her children; others report that Rolf herself was seeking alternative treatments after suffering from illnesses resulting from being kicked by a horse as a young woman.

After receiving her doctorate in biological chemistry, Rolf worked for the Rockefeller Institute. She eventually inherited some money and left the Institute to independently study various methods of physical therapy. She traveled to Switzerland, where she studied physics and homeopathic medicine and returned to the United States to study chiropractic medicine and yoga therapy. Around 1940, she began to develop her own theories of the mind–body connection based on the idea that both psychological and physical histories shape, and sometimes deform, people’s bodies, thickening connective tissue and tightening muscles in response to psychological as well as physical injury, and revealing past tensions and unexpressed angers. These abnormal tightenings and thickenings interfere with the flow of fluids and can sometimes block the free passage of nerves and nerve impulses through the body. She began traveling throughout the United States, Canada, and Europe, lecturing and demonstrating her method of “structural integration.” In the mid-1960s, she was invited to give demonstrations at the Esalen Institute in California, a community that tried to integrate elements of Eastern cultures, such as Zen Buddhism, and radical therapy systems, such as Gestalt psychotherapy. Although Rolf did not approve of the Esalen lifestyle, which included nudism

and drugs, the Institute provided a base of operations for her for a few years. In 1971, based on the success of her workshops at Esalen, she organized the Guild for Structural Engineering, later renamed the Rolf Institute of Structural Integration, in Boulder, Colorado.

The Institute continues to train Rolf practitioners to carry on her work, based on the principles laid out in her 1977 book, *Rolfing: The Integration of Human Structure*. There are presently more than 1,500 certified Rolf practitioners worldwide, and the method has received regular attention in the popular press. Most recently, the Rolfing method was featured on *The Oprah Winfrey Show* in April 2007. In some circles, it is still seen as controversial because Rolf did not have a medical degree, but also because the emotional release common at the sessions can be overwhelming for a patient without concurrent psychiatric treatment.

Further Resources

The Rolf Institute of Structural Integration. <http://www.rolf.org/>.

Roman, Nancy Grace

b. 1925

Astronomer

Education: B.A., Swarthmore College, 1946; Ph.D., astronomy, University of Chicago, 1949

Professional Experience: assistant, Swarthmore College Observatory, 1943–1946; graduate assistant, astronomy and astrophysics, University of Chicago, 1946–1948, research associate, stellar astronomy, Yerkes Observatory, University of Chicago, 1949–1951, instructor, 1951–1954, assistant professor, 1954–1955; astronomer, Radio Astronomy Branch, U.S. Naval Research Laboratory, 1955–1956, head, Microwave Spectroscopy Section, 1956–1957, consultant, 1958–1959; head, observational astronomy program, National Aeronautics and Space Administration (NASA), 1959–1960, chief astronomer, 1960–1979, program scientist, Hubble Space Telescope, 1979–1980, principal scientist, Astronomical Data Center, Goddard Space Flight Center, 1981–1997, astronomer/programmer, Sigma Data and MA/Com, 1981–1986, principal scientist, Hughes STX, 1986–1996, head, Astronomical Data Center, 1995–1997, chief scientist, 1997; teacher training, Montgomery College, Maryland, 1997–1999

Concurrent Positions: consultant, ORI, Inc. 1980–1989; senior professional, Space Systems Division, McDonnell Douglas, 1988–1994

Nancy Roman is renowned for developing satellite observatories to explore the universe from a vantage point that is free from atmospheric interference. She pioneered the use of satellites for gamma ray, x-ray, and radio observations, and she has also used traditional Earth-based telescopes to study topics such as stellar motions, photoelectric photometry, and spectroscopy. She is especially noted for the research she conducted at NASA, where for many years she was the highest-ranking woman scientist. The opening of the astronaut program to women in 1978, and the launch of NASA's moon program in 1988, greatly expanded opportunities for women scientists, but Roman and a few others achieved recognition for their work prior to that program. In a 1964 NASA-approved book, *Scientists Who Work with Astronauts*, by Lynn and Gray Poole, astronomers Nancy Roman and **Jocelyn Gill** were the only two women who were profiled.

Roman's association with NASA began in 1959, when she was appointed head of the observational astronomy program. She developed an ambitious plan to observe objects in space by using rocket and satellite observatories, and in the 1960s, she designed instrumentation and made substantial measurements from gamma ray, radio, and visible light satellites, such as the orbiting solar observatories. Her programs provided astronomers with the planetary surface knowledge that led to the successful 1976 *Viking* probes to collect data from Mars. In the 1970s, her papers dealt with new satellite data, but she still did Earth-based observation, such as at Kitt Peak Observatory. Asteroid number 2516 Roman is named after her. In the 1970s and 1980s, she measured x-ray and ultraviolet readings from the successful OAO-3, or *Copernicus*, satellite, and recorded stellar spectra from the U.S. space station *Skylab*, which circled the Earth between 1973 and 1979. She was also the NASA program scientist for a planned space telescope, and the Hubble was eventually launched in 1990. She has also worked as a consulting astronomer for the Astronomical Data Center, editing and documenting astronomical catalogs for electronic archiving.

Roman has also been committed to science education, and during the late 1990s, she team-taught courses for advanced students and K–12 science teachers. Roman has received numerous honorary degrees. She is a fellow of the American Astronautical Society and American Association for the Advancement of Science, and a member of the American Astronomical Society.

Further Resources

Montgomery College. Faculty website. <http://www.montgomerycollege.edu/Departments/planet/Nancy/Nancy.htm>.

Romanowicz, Barbara

b. 1950

Geophysicist, Seismologist

Education: Ecole Normale Supérieure, “Sèvres”, Paris, France, 1970–1974; Maîtrise de Mathématiques Pures, Université Paris, 1972; Agrégation de Mathématiques, Paris, 1973; M.S., applied physics, Harvard University, 1975; Doctorat, astronomy, Université Paris, 1975; Doctorat d’Etat, Université Paris, Spécialité Géophysique, 1979

Professional Experience: Attachée de Recherches, C.N.R.S., Institut de Physique du Globe, Paris, 1978–1979; postdoctoral associate, Massachusetts Institute of Technology (MIT), 1979–1981; Chargée de Recherches, C.N.R.S., I. P. G., Paris, Director, Geoscope Program, 1981–1986, Directeur de Recherches, 1986–1990; professor, geophysics, University of California, Berkeley, and director, Berkeley Seismological Laboratory, 1991–

Barbara Romanowicz is a geophysicist and seismologist who studies earthquakes, plate tectonics, and deep-earth (from the crust to the inner core) structures and movement. She has been involved in the development of special tools and observatories for measuring global seismic activity on land and in the oceans, including as co-founder in 1985 of ORFEUS, a European data center for broadband seismology, and co-founder in 1986 of the Federation of Digital Seismic Networks (FDSN). In 1997, she collaborated on the Monterey Bay Ocean-Bottom International Seismic Experiment (MOISE), and since 2002 has been involved with the Monterey Bay Ocean-Bottom Broadband Seismometer experiment (MOBB) in collaboration with the Monterey Bay Aquarium Research Institute (MBARI). Trained in France, she has been a professor of geophysics and director of the Berkeley Seismological Laboratory in California since 1991. She also served as chair of the Department of Earth and Planetary Science at the University of California, Berkeley between 2002 and 2006.

Romanowicz was elected to the National Academy of Sciences in 2005. She is a fellow of the American Geophysical Union (president, Seismology Section, 1994–1998) and American Academy of Arts and Sciences, and has served on numerous government and scientific research committees, including the National Earthquake Prediction Evaluation Council, National Research Council Committee on the Science of Earthquakes, International Ocean Network Committee, and Advisory Council to the Southern California Earthquake Center. She is the recipient of the French Academy of Sciences Prize (Fonds Doistau-Blutet) (1989), Silver Medal of the Centre National de la Recherche Scientifique (French NSF) (1992), A. Wegener Medal of the European Union of Geosciences (1999), and Gutenberg Medal of the European Geophysical Society (2003).

Further Resources

University of California, Berkeley. Faculty website. http://eps.berkeley.edu/development/view_person.php?uid=8698.

Monterey Bay Aquarium Research Institute. "New Seafloor Observatory Provides Round-the-Clock Monitoring of Ocean and Earth." (18 March 2009). Monterey Ocean-Bottom Broadband Seismometer. <http://www.mbari.org/news/homepage/2009/mars-mobb-deimos.html>.

Rose, Flora

1874 1959

Home Economist

Education: B.S., Kansas State Agricultural College, 1904; M.A., food and nutrition, Columbia University, 1909; Ped.D., New York State College for Teachers, 1931; Sc.D., Kansas State Agricultural College, 1937

Professional Experience: instructor, food and nutrition, Kansas State College, 1903–1906; lecturer, home economics, Cornell University, 1907–1911, professor, home economics, 1911–1940, co-director, School of Home Economics, 1919–1925, co-director, New York State College of Home Economics, 1925–1932, director, 1932–1940, emeritus professor

Flora Rose was recognized for her research in nutrition, weight control, and the science of homemaking. She received her undergraduate degree from Kansas State College and taught there for four years before attending Columbia University in New York. She earned a master's degree in food and nutrition from Columbia and then spent 30 years as co-director (with **Martha Van Rensselaer**) and then director of the School of Home Economics at Cornell University, later established as the separate New York State College of Home Economics. Rose and Van Rensselaer were reformers who led a campaign to start



Home economist Flora Rose. (Courtesy of Cornell University)

programs in home economics at major universities and were instrumental in persuading the New York legislature to create the program at Cornell. Rose became a lecturer and then professor in home economics through the agriculture department, and then co-director and, after Van Rensselaer's death, director of the New York State College of Home Economics. Rose and Van Rensselaer were the first women faculty members at Cornell to be promoted to full professors and were an inseparable administrative team (one colleague addressed them together as "Miss Van Rose"). They also shared their personal lives as well, living together until Van Rensselaer's death in 1932.

In the first decades of the twentieth century, the U.S. Department of Agriculture instituted programs for vocational education in public schools and for agricultural extension services for adults, including housewives. This opened up an unprecedented amount of funding for jobs for women as teachers and researchers in home economics and nutrition. As a nutrition researcher, Rose focused on dietary needs to fit household budgets, in particular the development of low-cost fortified cereals and the effect of nutrition on health and infant mortality. During World War I, she helped organize food relief program for children in Belgium, activities that earned her recognition with the Order of the Crown. After retiring in 1940, she moved to California, where she continued with her research and teaching through the California State Health Department. Rose authored or co-authored several books, including, *A Manual of Home-Making* (1919), *The New Butterick Cook-Book* (1924), and *Pioneers in Home Economics* (1948). She was a member of the American Association for the Advancement of Science.

Further Resources

Cornell University Library. Faculty biography. <http://rmc.library.cornell.edu/homeEc/bios/florarose.html>.

Rose, Mary Davies Swartz

1874 1941

Chemist and Nutritionist

Education: Litt.B., Denison University, 1901; diploma, home economics, Mechanics Institute, 1902; B.S., Columbia University, 1906; Ph.D., physiological chemistry, Yale University, 1909

Professional Experience: high school teacher, 1899–1905; assistant, nutrition, Teachers College, Columbia University, 1906–1907, instructor, nutrition and dietetics, 1909–1910, assistant to associate professor, 1911–1923, professor, 1923–1940

Mary Swartz Rose was a pioneer in research on nutrition and dietetics, including the vitamin content of food, protein comparison, effects of nutrients on anemia, metabolism, and trace elements in the diet. She was appointed an assistant professor of nutrition at Teachers College a year after the department was established, and the department became a national university center for training teachers of nutrition. She published more than 40 scientific papers and two widely used textbooks, *A Laboratory Hand-Book for Dietetics* (1912) and *The Foundations of Nutrition* (1927). She also wrote popular books for mothers, *Feeding the Family* (1916) and *Teaching Nutrition to Boys and Girls* (1932). After receiving a certificate from Denison University in 1901 and a diploma in home economics from the Mechanics Institute in Rochester, New York, in 1902, she taught high school home economics for five years. She then enrolled in Teachers College, Columbia University, where she received her undergraduate degree in 1906, remaining another year as an assistant in the household arts department. Since there were no graduate programs in nutrition at the time, she enrolled in Yale, where she received her doctorate in physiological chemistry in 1909. She met Anton Rose when both were graduate students at Yale; they were married in 1910 and had one son, Richard. She returned to Teachers College to become the first full-time instructor in nutrition and dietetics. She organized a program in which students could secure a solid grounding in the scientific aspects of nutrition as well as in the best methods for teaching the subject. She was promoted to assistant professor in 1911, associate professor in 1918, and professor in 1923.

A charter member of the American Institute of Nutrition, she was its president in 1937 and 1938 and associate editor of its publication, *Journal of Nutrition*, from 1928 to 1936. The American Dietetic Association elected her an honorary member in 1919. Teachers College established a scholarship and the Greater New York Dietetic Association established a lectureship in her name. She also was a member of the American Association for the Advancement of Science, the American Society of Biological Chemists, the Society of Experimental Biology and Medicine, the American Home Economics Association, and the American Public Health Association. Her biography is *Mary Swartz Rose: Pioneer in Nutrition* (1979) by Juanita A. Eagles, et.al. Beginning in 2008, the American Society for Nutrition and the Council for Responsible Nutrition co-sponsor two awards in her name, the Mary Swartz Rose Young Investigator Award and the Mary Swartz Rose Senior Investigator Award.

Rosenblatt, Joan (Raup)

b. 1926

Mathematical Statistician

Education: B.A., mathematics, Barnard College, 1946; Ph.D., statistics, University of North Carolina, 1956

Professional Experience: statistical analyst, National Institute of Public Affairs and Bureau of the Budget, 1948; assistant statistician, University of North Carolina, 1953–1954; mathematician, National Bureau of Standards, 1955–1969, chief statistician, Engineering Laboratory, 1969–1978, deputy director, Computer and Applied Mathematics Laboratory, National Institute of Standards and Technology, 1979–1993, director, 1993–1996

Joan Rosenblatt was renowned for her research as a mathematical statistician at the National Institute of Standards and Technology, formerly the National Bureau of Standards. The mission of the institute is to maintain and disseminate the basic units of measurement such as mass, length, temperature, frequency, and electrical units for application in industry and government regulations. Her research includes nonparametric statistical theory, applications of statistical techniques in the physical and engineering sciences, and the reliability of complex systems. At the National Bureau, Rosenblatt provided statistical consulting services to all parts of the institute and researched improved statistical methods for applications in the physical and engineering sciences as well. The research problems with which Rosenblatt was concerned in the early 1990s arose from the proliferation of new federal regulations based on physical measurements of such things as water, air, pesticides, noise, radiation, occupational health and safety, and transportation safety. One of the most difficult problems was how to measure chemical additives in food that the Food and Drug Administration handles to satisfy regulations that bar the use of known cancer-causing additives in food processing.

Rosenblatt grew up in a family that stressed education, and both her parents held Ph.D.s. Her mother, Clara Eliot Raup, a professor of economics at Barnard College, was among the first to promote the study of consumer economics and was also a role model for combining career and motherhood, being the first woman at Barnard to receive an unpaid maternity leave. After receiving her undergraduate degree, Rosenblatt worked for several government agencies before returning to graduate school and completing her doctorate in 1956. She spent 40 years in government employment, retiring in 1996.

Among the awards Rosenblatt has received are the Federal Woman's Award (1971), the Gold Medal of the Department of Commerce (1976), and the Founders Award of the American Statistical Association in 1991. She was a member of the

Committee on Applications and Theoretical Statistics of the National Research Council from 1985 to 1988. She is a fellow of the American Association for the Advancement of Science, American Statistical Association, and Institute of Mathematical Statistics, and a member of the American Mathematical Society and International Statistical Institute.

Further Resources

Murray, Margaret Anne Marie. 2000. *Women Becoming Mathematicians: Creating an Identity in Post World War II America*. Cambridge, MA: MIT Press.

Rowley, Janet Davison

b. 1925

Cytogeneticist, Geneticist

Education: B.S., anatomy, University of Chicago, 1946, M.D., 1948

Professional Experience: research assistant, University of Chicago, 1949–1950; resident, Marine Hospital, U.S. Public Health Service, Chicago, 1950–1951; physician, Infant Welfare and Prenatal Clinics, Department of Health, Montgomery County, Maryland, 1953–1954; research fellow, Cook County Hospital, Chicago, 1955–1960; instructor, neurology, University of Illinois Medical School, 1961; trainee, radiobiology, Churchill Hospital, England, 1961–1962; research associate, Department of Medicine and Argonne Cancer Research Hospital, University of Chicago, 1962–1969, associate professor, Department of Medicine and Franklin McLean Memorial Research Institute, 1969–1977, professor, 1977–1984, Blum-Riese Distinguished Service Professor, Medicine, Molecular Genetics and Cell Biology, and Human Genetics, 1984–

Janet Rowley is a cytogeneticist internationally renowned for her research on chromosome abnormalities in a form of leukemia and lymphoma. Cytogeneticists investigate the role of cells in evolution and heredity, and Rowley's research has introduced new diagnostic tools for oncologists and opened new avenues to possible gene therapies for cancer. She has helped to pinpoint cancer gene locations and correlate them to chromosome aberrations. During her long career at the University of Chicago, she developed the use of quinacrine and Giemsa staining to identify chromosomes in cloned cells, and thus was able to identify abnormalities that occur in some chromosomes in certain cancers. In 1972, she was the first person to discover the recurring translocation, or shifting, of genetic material, and since that time, more than 70 such translocations have been detected in human malignant cells. Her research indicated that both translocations and deletions of



Cytogeneticist Janet Rowley is presented with the Presidential Medal of Freedom by President Barack Obama, 2009. (AP/Wide World Photos)

genetic material occur in malignancy and that cancer is caused by a complex series of events within a single cell, making some genes overactive and eliminating other genes that would normally suppress growth. Her research revealed that any cell is potentially cancerous.

Starting with her undergraduate studies in the 1940s, Rowley has had a long association with the University of Chicago for the majority of her career. In addition to her numerous scientific papers, she is the author of *Chromosome Changes in Leukemia* (1978) and the editor or co-editor of *Chromosomes and Cancer: From Molecules to Man* (1983), *Genes and Cancer* (1984), *Consistent and Chromosomal Aberrations and Oncogenes in Human Tumors* (1984), and *Advances in Understanding Genetic Changes in Cancer* (1992). She is co-founder and co-editor of the journal, *Genes, Chromosomes and Cancer*.

Rowley was elected to membership in the National Academy of Sciences in 1984 and the Institute of Medicine 1985. She received the National Medal of Science in 1999 and in 2009 received the Presidential Medal of Freedom, the nation's highest civilian honor. She has received almost every major cancer-research award, including the Esther Langer Award (1983), the Kuwait Cancer Prize (1984), the A. Cressy

Morrison Award from the New York Academy of Sciences (1985), the Judd Memorial Award from the Sloan-Kettering Cancer Center (1989), the Charles S. Mott Prize from General Motors Research Foundation (1989), the G. H. A. Clowes Memorial Award from the American Association for Cancer Research (1989), the Robert de Villiers Award from the Leukemia Society of America (1993), the Gairdner International Prize (1996), the Albert Lasker Clinical Medicine Research Prize (1998), the Franklin Medal of the American Philosophical Society (2003), and the Genetics Prize of the Peter and Patricia Foundation (2009). She is a member of the American Academy of Arts and Sciences, American Philosophical Society, American Society of Human Genetics (president, 1993), American Society of Hematology, and American Association for Cancer Research. She has received honorary doctorates from the University of Arizona, the University of Pennsylvania, Knox College, the University of Southern California, and Harvard University.

Further Resources

University of Chicago. Faculty website. <http://experts.uchicago.edu/experts.php?id=212>.

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

Roy, Della Martin

b. 1926

Geochemist, Materials Scientist

Education: B.S., chemistry, University of Oregon, 1947; M.S., mineralogy, Pennsylvania State University, 1949, Ph.D., mineralogy, 1952

Professional Experience: assistant, mineralogy, Pennsylvania State University, 1949–1952, research associate, geochemistry, 1952–1959, senior research associate, 1959–1969, associate professor, materials science, 1969–1975, professor, Materials Research Laboratory, 1975–1992, emerita

Della Roy is known for her research in materials science, which is concerned with the uses of new materials and their applications to existing processes and products. Her research includes phase equilibria, materials synthesis, crystal chemistry and phase transitions, crystal growth, cement chemistry, hydration and microstructure, concrete durability, biomaterials, special types of glass, radioactive waste management, geological isolation, chemically bonded ceramics, and waste management science. Much of the new materials-science research arose from the aeronautics and nuclear energy programs starting in the 1950s, around the time Roy received her Ph.D.

Although Roy's background is in mineralogy, she has worked with many types of materials, including ceramics, biomaterials, and concrete. She founded a journal for *Cement and Concrete Research* in 1971. Although her husband, Rustum Roy, is internationally known for his research in materials science, science policy, and alternative medicine, and the two collaborated on scientific papers, Della Roy maintained her own research programs and, in addition to receiving four patents, authored or co-authored hundreds of scientific papers. Both she and her husband had minerals named after them: *dellaite* and *rustumite*. After receiving her doctorate from Pennsylvania State University, she was appointed as an assistant in mineralogy and progressed through the ranks to senior research associate and then full professor in the Materials Research Laboratory. She formally retired in 1992, but continues her affiliation and research at Pennsylvania State University.

Roy was elected to the National Academy of Engineering in 1987. She has been a member of the Highway Research Board of the National Academy of Sciences, was chair of a National Academy of Sciences Research Committee on Concrete (1980–1983), and was a member of the Committee on Concrete Durability (1986–1987). She has received numerous awards, including the Jepson Medal (1982) and the Copeland Award (1987) of the American Ceramic Society, and the Slag Award of the American Concrete Institute (1989). She was made an honorary fellow of the Institute for Concrete Technology in 1987 and is a fellow of the Mineralogical Society of America, American Concrete Society, American Ceramic Society, and American Association for the Advancement of Science, and a member of the Materials Research Society, Geochemical Society, Clay Minerals Society, Concrete Society (UK), American Nuclear Society, American Society for Testing and Materials (ASTM), and Society of Women Engineers.

Further Resources

Pennsylvania State University. Faculty website. <http://www.mri.psu.edu/faculty/dmr.asp>.

University of Oregon College of Arts & Sciences. "Alumni. Della Roy '47: Cement Paves the Way to Illustrious Career." Alumni & Development. (19 June 2007). <http://uoregon.edu/~wits/wits/files/pdf/della-roy.pdf>.

Rubin, Vera (Cooper)

b. 1928

Astronomer, Cosmologist

Education: B.A., Vassar College, 1948; M.A., physics, Cornell University, 1951; Ph.D., astronomy, Georgetown University, 1954

Professional Experience: instructor, mathematics and physics, Montgomery County Junior College, 1954–1955; research associate astronomer, Georgetown University, 1955–1965, lecturer, 1959–1962, assistant professor, astronomy, 1962–1965; staff member, Department of Terrestrial Magnetism, Carnegie Institution of Washington, 1965–

Concurrent Positions: associate editor, *Astronomical Journal*, 1972–1977; associate editor, *Astrophysical Journal Letters*, 1977–1982; editorial board, *Science Magazine*, 1979–1987; Beatrice Tinsley visiting professor, astronomy, University of Texas, Austin, 1988

Vera Rubin is a specialist in the branch of astronomy called *cosmology*, which deals with the general structure and origin of the universe. She is one of America's foremost astronomers, and has spent her career observing galactic structure, rotation, and dynamics. Her pioneering research in the 1970s demonstrated the possible existence of a large percentage of matter in the universe that is invisible to the naked eye, and astronomers now estimate that up to 90% of the universe may be composed of this "dark matter." She studied physics at Cornell, where, for her master's thesis, she analyzed the motion of 108 galaxies and discovered that they shared a large-scale, systematic motion in addition to motion resulting from the expansion of the universe. When she presented her findings at a meeting of the American Astronomical Society in 1950, the scientific community was not prepared to believe in large-scale motions, and her work generated great controversy. Several years later, she was vindicated when a noted cosmologist agreed with her theory. Her doctoral advisor was applying nuclear physics to Big Bang cosmology, and her dissertation, again ahead of her time, showed that instead of being randomly distributed, galaxies tend to clump together.

Rubin did not start doing observational astronomy until the 1960s and, with colleague Kent Ford, found evidence that a large group of galaxies,



Astronomer and cosmologist, Vera Rubin.
(Courtesy of the Carnegie Institution)

Support for Iraqi Women Scientists

Through the U.S. National Academy of Sciences' Committee on Human Rights, several prominent American women scientists helped launch a "twinning project" in 2007 to provide professional and social support to Iraqi women scientists and engineers whose careers and research have been disrupted by war. The program is chaired by **Maxine Singer**, **Vera Rubin**, and **Myriam Sarachik**, and invites women members of the NAS, the National Academy of Engineering (NAE), and the Institute of Medicine (IOM) to be paired with Iraqi colleagues and provide them with information, news and scientific papers in their field, and moral support. The network reaches out to women living in Iraq as well as those who have fled to other countries and are attempting to continue their work. The program works in consultation with human-rights groups, nongovernmental organizations, and private groups, and does not rely upon funding from the U.S. government.

including the Earth's Milky Way, are moving rapidly with respect to the rest of the universe. Although the theory was immediately controversial, this time the astronomy community took "the Rubin-Ford effect" seriously. Rubin and Ford found that stars at the outer margins of galaxies travel as rapidly as stars closer to the galaxy center. This indicates that there must be a large amount of invisible matter, even at the fringe of a galaxy, where the number of visible stars dwindles, because matter is necessary to accelerate the outer stars in their rapid orbits. Rubin theorized that a huge reservoir of extra material that is invisible to the telescope must be part of each galaxy, and her team has analyzed 200 galaxies in pursuit of this research. Her work on spiral galaxies was discussed on the public television show, *Stephen Hawking's Universe: On the Dark Side*, in 1997.

Rubin was elected to membership in the National Academy of Sciences (NAS) (1981) and received the National Medal of Science (1993). She was also awarded the NAS James Craig Watson Medal (2004) "for her seminal observations of dark matter in galaxies, large-scale relative motions of galaxies, and for generous mentoring of young astronomers, men and women." She has received numerous honorary degrees and other awards, including the Russell Lecturer Prize of the American Astronomical Society (1994), Gold Medal of the Royal Astronomical Society (1996), Women and Science Award of the Weizmann Institute (1996), Cosmology Prize of the Peter Gruber Foundation (2002), Bruce Medal of the Astronomical Society of the Pacific (2003), and Distinguished Achievement Award of Vassar College (2007). In 2008, she became co-chair (with geneticist **Maxine Singer** and physicist **Myriam Sarachik**) of an NAS project to pair

women scientists in the United States with Iraqi women scientists for mentoring and career support.

Further Resources

Carnegie Institution. Faculty website. <http://www.dtm.ciw.edu/rubin/>.

National Academy of Sciences. 2008. "International Twinning Project for Iraqi Women Scientists, Engineers, and Health Professionals." Committee on Human Rights. (March 2008). http://sites.nationalacademies.org/PGA/humanrights/PGA_044086.

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

Byers, Nina and Gary A. Williams. 2006. *Out of the Shadows: Contributions of Twentieth-Century Women to Physics*. New York: Cambridge University Press.

Rudin, Mary Ellen (Estill)

b. 1924

Mathematician

Education: B.A., University of Texas, Austin, 1944, Ph.D., mathematics, 1949

Professional Experience: instructor, mathematics, Duke University, 1950–1953; assistant professor, University of Rochester, 1953–1957; lecturer, University of Wisconsin, Madison, 1959–1970, professor, mathematics, 1971–1991, emerita

Mary Ellen Rudin is renowned for her contributions to set-theory topology in mathematics, particularly the construction of counterexamples. Topology is an abstract geometry that looks at the properties of mathematical spaces. She entered the University of Texas with no specific plans for an area of study, but was mentored by an unorthodox mathematics research professor by the name of R. L. Moore. At the time she completed her Ph.D., in 1949, many universities were under pressure to hire women mathematicians, and Rudin found a job as an instructor at Duke University. She met and married mathematician Walter Rudin at Duke, and they moved to the University of Rochester and then on to the University of Wisconsin, Madison. At Madison, she was only able to work as a lecturer due to an anti-nepotism rule, but after the rules were changed in 1971, she was promoted to full professor. Each summer at the University of Wisconsin, there were mathematics conferences and collaborations, and in 1974, Rudin gave a series of 10 lectures that were subsequently published as *Lectures on Set Theoretic Topology* (1975). Rudin was considered one of the best-known female mathematicians of her generation. In 1991, a conference, "The Work of Mary Ellen Rudin," was held

in her honor at Madison, and the proceedings were published in the *Annals of the New York Academy of Sciences* (1993).

Rudin's family was committed to the value of education. Both of her parents and even both of her grandmothers had college degrees, and her family insisted that girls as well as boys should have the opportunity for further education. She has exhibited outstanding dedication and service to her profession and has written more than 90 research papers or book chapters. She has been recognized nationally as well as internationally, serving on advisory boards for the National Academy of Sciences and National Science Foundation, and as a visiting professor at institutions in New Zealand, Mexico, and China. Rudin is a member of the American Mathematical Society, Mathematical Association of America, the Association for Women in Mathematics, and the Association for Symbolic Logic, and a fellow of the American Academy of Arts and Sciences. In 1995, she was elected to the Hungarian Academy of Sciences and has been honored by the Mathematical Society of The Netherlands.

Further Resources

Henrion, Claudia. 1997. *Women in Mathematics: The Addition of Difference*. Bloomington: Indiana University Press.

Murray, Margaret Anne Marie. 2000. *Women Becoming Mathematicians: Creating an Identity in Post World War II America*. Cambridge, MA: MIT Press.

Rudnick, Dorothea

1907–1990

Embryologist

Education: B.A., languages, University of Chicago, 1928, Ph.D., zoology, 1931

Professional Experience: fellow, Yale University, 1931–1934; research fellow, University of Rochester, 1934–1937; assistant instructor, genetics, Storrs experiment station, University of Connecticut, 1937–1939; instructor, zoology, Wellesley College, 1939–1940; assistant professor, biology, Albertus Magnus College, New Haven, Connecticut, 1940–1948, professor, 1948–1977; research associate, Yale University, 1940–1971, associate fellow, 1969–1977

Concurrent Positions: Guggenheim fellow, 1952–1953; U.S. Public Health Service special fellow, 1965–1966

Dorothea Rudnick was recognized for her research in embryology, which focused on experimental embryology of the chick and rat; developmental genetics of the

chick; and enzymatic development in the liver, brain, and retina of the chick. She discovered an interest in the sciences as an undergraduate taking courses in zoology and embryology. While still in graduate school, her research on chick embryos was published in a scientific journal. After receiving her doctorate from the University of Chicago in 1931, she was a fellow of the Osborne Zoological Laboratory at Yale and then a National Research Fellow at the University of Rochester. In 1937, she accepted a position as assistant instructor at the University of Connecticut and as instructor in zoology at Wellesley in 1939. She was appointed assistant professor of biology at Albertus Magnus in 1940, and advanced to full professor in 1948. Albertus Magnus was a small liberal-arts college with very limited laboratory facilities, so she maintained a lab at nearby Yale University, where she conducted studies on the embryology of the chick and rat. In 1952, she won a Guggenheim fellowship to conduct research and lecture in Europe. She retired from Yale in 1977.

Rudnick came from a family of scientists; her father was a chemist and her two brothers became physicists. She originally studied languages in college, however, but later combined her fluency in several European languages and her interest in science by writing book reviews of English, French, and German works and translating a biography of a German scientist, *Theodor Boveri: Life and Work of a Great Biologist*. For several years, she served as editor of the symposia of the Society for the Study of Growth and Development, and secretary and editor at the Connecticut Academy of Arts and Sciences. She was a member of the American Association for the Advancement of Science, American Society of Zoologists, American Association of Anatomists, Society for Developmental Biology, Tissue Culture Association, and International Institute of Embryology.

Russell, Elizabeth Shull

1913–2001

Geneticist

Education: A.B., zoology, University of Michigan, 1933; A.M., Columbia University, 1934; Ph.D., genetics, University of Chicago, 1937

Professional Experience: assistant, zoology, University of Chicago, 1935–1937; independent investigator, Roscoe B. Jackson Laboratory, Bar Harbor, Maine, 1937–1940, research associate, 1946–1957, senior staff scientist, 1957–1978, emeritus senior scientist, 1978–1988

Concurrent Positions: Guggenheim fellow, 1958–1959

Elizabeth Russell was a pioneer in genetics who bred and distributed millions of mice for scientific research around the world. Her early research was on fruit flies, but she became interested in mammalian genetics and began working with mice, the genetic makeup of which is 95 percent identical to that of humans. Her research focused on pigmentation, hereditary anemia, muscular dystrophy, cancer, and the genetic effects on aging. Her work on marrow transplants in mice had implications for later human treatments. She spent much of her career at the Roscoe B. Jackson Laboratory in Bar Harbor, Maine, which is known internationally for its research in breeding mice (now known by the brand name JAX Mice) to represent specific genetic conditions. When a fire broke out at the laboratory in 1947, it destroyed thousands of mice, and Russell was in charge of rebuilding the stock, a task that took another 10 years.

Russell came from a strong family background in science. Her father, Aaron Franklin Shull, taught zoology and genetics at the University of Michigan, and her mother, Margaret Jeffrey Buckley, had a master's degree in zoology and had taught at Grinnell College in Iowa. After receiving her master's degree from Columbia in 1934, Elizabeth Shull joined the University of Chicago as an assistant in zoology while she completed her doctorate. She received her Ph.D. in 1937 and, that same year, married fellow graduate student William L. Russell. The couple began working at the Jackson Laboratory, although Elizabeth was unable to secure a full-time permanent position due to anti-nepotism rules. She began her career as an independent investigator at the lab, and took several years off in the 1940s, probably due to family responsibilities, as the couple had four children. The couple divorced in 1947, however, and Elizabeth returned to work at Jackson as a research associate, then senior staff scientist. She organized a conference at Jackson of scientists from around the globe and subsequently received a Guggenheim fellowship to pursue her research on mammalian genetics. She formally retired in 1988 after several years as an emeritus senior scientist and traveled twice to Liberia, West Africa as a visiting instructor at Cuttington College.

Russell was elected to the National Academy of Sciences in 1972. She was a trustee for several colleges in Maine and in 1991 was inducted into the Maine Women's Hall of Fame. She was a member of the American Academy of Arts and Sciences, the Genetics Society of America (vice president, 1974; president, 1975–1976), the American Philosophical Society, the American Society of Naturalists, the Council of the National Institute on Aging, the Society for Developmental Biology, and the Union of Concerned Scientists.

Further Resources

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S

Sabin, Florence Rena

1871–1953

Anatomist

Education: B.S., Smith College, 1893; M.D., Johns Hopkins University, 1900

Professional Experience: school teacher, 1894–1895; assistant, zoology, Smith College, 1896; intern, Johns Hopkins Hospital, 1900–1901, assistant to associate, anatomy, School of Medicine, Johns Hopkins University, 1902–1905, associate professor, 1905–1917, professor, histology, 1917–1925; head, Department of Cellular Studies, Rockefeller Institute for Medical Research, New York, 1925–1938; head, Committee on Health, Colorado, 1945–1947; manager, Department of Health and Charities, Denver, Colorado, 1947

Florence Sabin is regarded as one of the outstanding woman scientists in the medical field in the first half of the twentieth century. As a medical student, she had shown great interest in research, and she published her first paper, on the nuclei of cochlear and vestibular nerves, during her second year. She received her medical degree in 1900 and chose to continue in research and teaching. She was the first female faculty member at Johns Hopkins Medical School when she was appointed in 1902 and was the first woman to advance to full professor in 1917. Her major areas of research were the origin of the lymphatic vessels, the study of red and white corpuscles, and the pathogenesis of tuberculosis. Her first research efforts were in a controversial field, the origin of lymphatic vessels. By using the approach of injecting lymphatic channels with India ink, she demonstrated that the vessels derived from the venous system. This work caused considerable controversy but ultimately was acclaimed as a highly significant contribution. Other important contributions included the development of supravital staining techniques for living cells and the identification of the monocyte as a definitive type of white blood cell.

Sabin left Johns Hopkins and accepted a position as a member of the Rockefeller Institute in 1925, where she conducted significant research on tuberculosis before retiring as emeritus member in 1938. After she retired, she returned to her native Colorado and continued her involvement with public health issues. She began what was, effectively, another career when she was asked to head the Colorado State

Committee on Health, established after the end of World War II. Her first project was to conduct health surveys of Colorado residents, and she drafted several pieces of public-health legislation to address the high mortality rate and poor healthcare systems in the state. In 1947, she was appointed head of Health and Charities for the city of Denver, and set out to improve public health and hygiene standards in hospitals and restaurants, and to promote preventative healthcare in identifying tuberculosis and other contagious diseases.

Sabin was the first woman elected to the National Academy of Sciences (1925). She was also the first woman president of the American Association of Anatomists (1924–1926). She received honorary degrees from a dozen universities. Among her other honors and awards were the National Achievement Award (1932), M. Carey Thomas Prize (1935), Trudeau Medal of the National Tuberculosis Association (1945), and Albert Lasker Public Service Award (1951). A bronze statue was placed in her honor in Statuary Hall in Washington, D.C. In addition to her numerous scientific papers, she was the author of *An Atlas of the Medulla and Mid-Brain* (1901) and *Biography of Franklin Paine Mall* (1934). She was a member of the American Association for the Advancement of Science, the American Physiological Society, the Society for Experimental Biology and Medicine, the Harvey Society, and the National Tuberculosis Association, and an honorary member of the New York Academy of Sciences.

Further Resources

National Institutes of Health. “The Florence R. Sabin Papers.” Profiles in Science, National Library of Medicine. <http://profiles.nlm.nih.gov/RR/>.

Sager, Ruth

1918–1997

Geneticist

Education: B.S., University of Chicago, 1938; M.S., plant physiology, Rutgers University, 1944; Ph.D., genetics, Columbia University, 1948

Professional Experience: Merck postdoctoral fellow, Rockefeller Institute for Medical Research, 1949–1951, assistant biochemist, 1951–1955; research associate, zoology, Columbia University, 1955–1960, senior research associate, 1960–1966; professor, biology, Hunter College, 1966–1975; professor, cellular genetics and chief, Division of Cancer Genetics, Dana-Farber Cancer Institute, Harvard Medical School, 1975–1988

Ruth Sager was a geneticist who pioneered the development of experimental material for the analysis of nonchromosomal heredity, called *non-Mendelian inheritance* or *cytoplasmic inheritance*. Her research interests included organelle genetics and biogenesis, mammalian cell genetics, genetic mechanisms of carcinogenesis, tumor suppressor genes, and breast cancer. Sager began her scientific career as a graduate student at Columbia University, where she studied plant genetics and was heavily influenced by the work of contemporary renowned geneticist **Barbara McClintock**. Sager held a postdoctoral fellowship to work with a microbiologist at the Rockefeller Institute for Medical Research, and she concentrated her own research on chloroplast DNA. She returned to

Columbia as a research associate and collaborated with Professor Francis Ryan on their book on *Cell Heredity*, published in 1961.

Sager's work changed the way biologists think about cell heredity. Still, there was a long delay in recognizing her achievements in academia, and she was not appointed a full professor until she moved to Hunter College in 1966, 18 years after receiving her doctorate. She had moved toward cancer research when she spent a year in London at the Imperial Cancer Research Fund Laboratory as a Guggenheim fellow. In 1975, she was invited to head the Dana-Farber Cancer Institute at Harvard, where she and her colleagues researched the growth of cancer cells and the search for tumor-suppressor genes, and had some success working with breast cancer cells. She retired from Harvard in 1988 but continued to be a voice for cancer research. She died of bladder cancer in 1997.

Sager was elected to the National Academy of Sciences in 1977 and the Institute of Medicine in 1992. Among her honors and awards, she received the Gilbert Morgan Smith Medal of the National Academy of Sciences (1988). She was a member of the American Society for Cell Biology, International Society for Cell Biology, Genetics Society of America, American Academy of Arts and Sciences, American Society of Biological Chemists and Molecular Biologists, American



Geneticist Ruth Sager, 1964. (AP/Wide World Photos)

Society of Naturalists, American Association of Cancer Research, and American Society of Human Genetics.

Further Resources

“Ruth Sager, Faculty of Medicine Memorial Minute.” *Harvard University Gazette*. (4 November 2004). <http://news.harvard.edu/gazette/2004/11.04/16-mm.html>.

Saif, Linda

b. 1947

Microbiologist, Animal Scientist

Education: B.A., College of Wooster, Ohio, 1969; M.S., microbiology, Ohio State University, 1971, Ph.D., microbiology and immunology, 1976

Professional Experience: postdoctoral research associate, Ohio Agricultural Research and Development Center (OARDC), Department of Veterinary Science, Ohio State University, 1976–1979, assistant to associate professor, Food Animal Health Research Program, 1979–1990, Distinguished University Professor, 1990–

Linda Saif is a microbiologist whose work on animal viruses gained international attention during the global SARS (Severe Acute Respiratory Syndrome) outbreak of 2002 and 2003. Her research focuses on animal digestive and respiratory viral infections, bases for immunities, the development of vaccines, and foodborne illnesses. Saif, a professor of food animal sciences at the OARDC, was called upon by the World Health Organization (WHO) and the U.S. Centers for Disease Control as head of one of the only laboratories in the world that had conducted research on a deadly coronavirus that had caused a global lethal infection of pigs; the virus could be transmitted from animals to humans, and was believed to be the pathogen responsible for SARS. Few biologists studying human viruses had encountered coronaviruses, and Saif and her husband, Mo Saif (also affiliated with the OARDC), consulted on ways to detect, respond to, and stop the spread of the SARS virus that killed nearly 1,000 people in less than one year. Her lab was invited to join the WHO’s elite network of International Reference Laboratories, an affiliation that has attracted graduate students and grant money to support her work.

Saif was raised in Ohio and spent much of her childhood in and around her grandparents’ farm. She earned her bachelor’s degree from the College of Wooster in 1969. She briefly attended Case Western Reserve University before receiving

her master's and doctorate in microbiology and immunology from Ohio State University in 1971 and 1976, respectively. She stayed on at the university, rising through the ranks from postdoctoral researcher to assistant professor, and in 2002 became a Distinguished University Professor, the highest faculty honor.

Saif was elected to the National Academy of Sciences in 2003. That same year, she received an honorary doctorate from Ghent University in Belgium. She has also received the Beecham Laboratories Award for Research Excellence (1989), a Distinguished Veterinary Immunologist Award from the American Association of Veterinary Immunologists (1995), and University Distinguished Scholar Awards from the Ohio State University (1995 and 2002). She is an honorary diplomate of the American College of Veterinary Microbiologists, an elected fellow of the American Association for the Advancement of Science, and a member of the Conference of Research Workers in Animal Diseases, American Society of Virology, and American Association of Veterinary Immunologists.

Further Resources

Ohio State University. "Dr. Linda Saif Laboratory." <http://www.oardc.ohio-state.edu/lisaiflab/>.

Sammet, Jean Elaine

b. 1928

Computer Scientist

Education: B.A., mathematics, Mount Holyoke College, 1948; M.A., mathematics, University of Illinois, 1949

Professional Experience: teaching assistant, mathematics, University of Illinois, 1948–1951; dividend technician, Metropolitan Life Insurance Company, 1951; teaching assistant, mathematics, Barnard College, 1952–1953; engineer, Sperry Gyroscope Company, 1953–1958; section head, MOBIDIC Programming, Sylvania Electric Products Company, 1958–1959, staff consultant, program research, 1959–1961; Boston advanced program manager, International Business Machines (IBM) Corporation, 1961–1965, program language technical manager, 1965–1968, program technology planning manager, 1968–1979, division software technical manager, 1979–1983, program language technology manager, 1983–1986, senior technical staff member, 1986–1988; consultant, 1989–

Concurrent Positions: lecturer, Adelphi College, 1956–1958, Northeastern University, 1967, University of California, Los Angeles, 1967–1972, Mount Holyoke College, 1974

Jean Sammet is renowned for her professional contributions to the use of computers for nonnumerical mathematics and for developments in the theory of high-level programming languages. She is most famous for her work on the design and development of COBOL and FORMAC, the most widely used programming language in the world from the late 1960s through the 1970s, primarily for commercial applications. She studied mathematics in college and graduate school, and began work on computers at Sperry Gyroscope in 1955 as supervisor of their first scientific programming group. At the same time, she was a lecturer on digital computer programming at Adelphi College, where she also taught one of the earliest courses on FORTRAN in the United States. She moved to Sylvania Electric Products in 1958 and oversaw the development of software for MOBIDIC, the U.S. Army computer system. During her Sylvania years, she was involved in the initial creation of COBOL.

In 1961, Sammet began her long association with IBM to organize and manage the Boston Programming Center. She initiated the concept, and directed the development of, FORMAC (FORMula MANipulation Compiler), the first widely used general language and system for manipulating nonnumeric algebraic expression. In 1965, she became programming language technology manager and then moved to the IBM Federal Systems Division in 1968, where she held various positions involving planning, internal consulting, and lecturing on programming languages. In 1969, she published a book, *Programming Languages: History and Fundamentals*, recognized as the “standard work on programming languages” and “an instant computer classic.” In 1979, she began work on “Ada,” the first programming language developed for the U.S. Department of Defense. In 1986, she was named a senior technical staff member; she formally retired from IBM in 1988, but continued to consult for the company.

Sammet was elected to membership in the National Academy of Engineering in 1977 and in 1978 received an honorary doctorate from her alma mater, Mount Holyoke College. Among her numerous other awards are IBM’s Outstanding Contribution Award (1965), Mount Holyoke College Alumnae Association Centennial Award (1972), Association for Computing Machinery (ACM) Distinguished Service Award (1985), Augusta Ada Lovelace Award of the Association for Women in Computing (1989), Distinguished Service Award of the ACM Special Interest Group on Programming Languages (SIGPLAN) (1997), and a Fellow Award of the Computer History Museum (2001). She is a member of the Mathematical Association of America and the Association for Computing Machinery, serving as president from 1974 to 1976. She was also a member of the board of directors of the Computer Museum in Boston (1983–1993).

Sarachik, Myriam Paula (Morgenstein)

b. 1933

Physicist

Education: B.A., physics, Barnard College, 1954; M.S., Columbia University, 1957, Ph.D., physics, 1960

Professional Experience: research assistant, solid-state physics, International Business Machines (IBM) Watson Laboratory, Columbia University, 1955–1960, research associate, 1960–1961; member of technical staff, AT&T Bell Laboratories, 1962–1964; assistant to associate professor, physics, City College of New York, 1964–1971, professor, 1971–1995, distinguished professor, 1995–

Concurrent Positions: principal investigator, U.S. Air Force research grant, 1965–1972, National Science Foundation grant, 1972–1974; executive officer, graduate program in physics, City College of New York, 1975–1978

Myriam Sarachik is an experimental condensed-matter physicist who is renowned for her research on superconductivity, disordered metallic alloys, metal-insulator transitions in doped semiconductors, hopping transport in solids, properties of strongly interacting electrons in two dimensions, and spin dynamics in molecular magnets. She was born Myriam Morgenstein in Antwerp, Belgium, and when she was just seven years old, her family began their escape from the Nazis that would take them to France, then Cuba, and on to New York. She attended the prestigious Bronx High School of Science and then majored in physics at Barnard College. While at Columbia working on a master's and then doctorate in physics, she worked as a research assistant and then a research associate in the IBM Watson Laboratory. After receiving her Ph.D. she worked on the technical staff of AT&T Bell Laboratories for two years, and then became an assistant professor of physics at the City College of New York. She rose through the ranks to become full professor in 1971 and then distinguished professor (the highest faculty rank) in 1995, a position she still holds.

Sarachik was elected to membership in the National Academy of Sciences (NAS) in 1994 and in 2008 was elected to the NAS 17-member Governing Council. Among her other most recent awards are the New York City Mayor's Award for Excellence in Science and Technology (1995), the Sloan Public Service Award from the Fund for the City of New York (2004), the Oliver E. Buckley Prize in Condensed Matter Physics (2005), and the L'Oréal-UNESCO Award for Women in Science (2005). She has served on numerous national and international boards and advisory panels, including for the National Science Foundation,

U.S. Department of Energy, American Institute of Physics, National Research Council, Zernike Institute for Advanced Materials of the University of Groningen, Netherlands, and Science Advisory Committee of the Hong Kong University of Science and Technology. She is a fellow of the American Physical Society (vice president, 2001; president, 2003), New York Academy of Sciences, American Academy of Arts and Sciences, and American Association for the Advancement of Science. In 2008, she became co-chair (with astronomer **Vera Rubin** and geneticist **Maxine Singer**) of a National Academy of Sciences project to pair women scientists in the United States with Iraqi women scientists for mentoring and career support.

Further Resources

National Academy of Sciences. 2008. "International Twinning Project for Iraqi Women Scientists, Engineers, and Health Professionals." Committee on Human Rights. (March 2008). http://sites.nationalacademies.org/PGA/humanrights/PGA_044086.

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

Byers, Nina and Gary A. Williams. 2006. *Out of the Shadows: Contributions of Twentieth-Century Women to Physics*. New York: Cambridge University Press.

Savitz, Maxine (Lazarus)

b. 1937

Organic Chemist, Electrochemist

Education: B.A., chemistry, Bryn Mawr College, 1958; Ph.D., organic chemistry, Massachusetts Institute of Technology, 1961

Professional Experience: National Science Foundation fellow, University of California, Berkeley, 1961–1962; instructor, chemistry, Hunter College, 1962–1963; research chemist, Electric Power Division, U.S. Army Engineering Research and Development Laboratory, Fort Belvoir, 1963–1968; associate professor, chemistry, Federal City College, 1968–1971, professor, 1971–1972; professional manager, Research Applied to National Needs, National Science Foundation, 1972–1973; chief, buildings conservation policy research, Federal Energy Administration, 1973–1975; division director, buildings and industrial conservation, Energy Research and Development Administration, 1975–1976, division director, buildings and community systems, 1976–1979, Deputy Assistant Secretary of Conservation, Department of Energy, 1979–1983; president, Lighting Research Institute, 1983–1985;

assistant to vice president of engineering, Ceramic Components Division, Garret Corporation, 1985–1987; general manager, Ceramic Components Division, AlliedSignal Aerospace Company (now Honeywell, Inc.), 1987–2000, general manager, Technology Partnerships, 2000–2006; vice president, National Academy of Engineering, 2006–

Maxine Savitz is an organic chemist who is recognized for her expertise in research management in both government and industry. Her research includes free radical mechanisms, anodic hydrocarbon oxidation, fuel cells, more efficient use of energy in buildings, community systems, appliances, agriculture and industrial processes, transportation, batteries and other storage systems, new materials, and advanced structural ceramic materials. She has spent recent years serving as general manager of different divisions at Honeywell, Inc. (formerly AlliedSignal) working on ceramics for aerospace applications. Earlier, she was an executive with the U.S. Department of Energy, establishing energy-saving guidelines for buildings during the oil crises of the 1970s. Recommendations of her team in the areas of longer-burning lighting, new batteries, and new technologies, and development of alternative fuels for vehicles and improved public transportation, were among the measures mandated by the Energy Conservation and Production Act of 1976.

Savitz was elected to membership in the National Academy of Engineering (NAE) in 1992, and in 2006 was elected to a four-year term as vice president of the NAE. Among her committee appointments are the Energy and Engineering Board of the NAE, the Office of Technical Assessment of the U.S. Congress Energy Demand Panel, the natural materials advisory board, National Research Council, the advisory committee of the division of ceramics/materials, Oak Ridge National Laboratory, the advisory board for the secretary of Energy, and the Defense Science Board. She is one of the directors of the Washington Advisory Group, and in 2009, she was appointed by President Obama to the Council of Advisors on Science and Technology (PCAST). Savitz is a member of the American Association for the Advancement of Science and American Ceramic Society, and a fellow of the California Council on Science and Technology (CCST).

Scarr, Sandra (Wood)

b. 1936

Psychologist

Education: B.A., sociology, Vassar College, 1958; M.A., Harvard University, 1963, Ph.D., psychology, 1965

Professional Experience: instructor, University of Maryland, 1964–1965, assistant professor, psychology, 1965–1966; lecturer, University of Pennsylvania, 1967–1968, assistant to associate professor, 1968–1971; associate professor, University of Minnesota, 1971–1973, professor, 1973–1977; professor, Yale University, 1977–1983; Commonwealth Professor of Psychology, University of Virginia, 1983–1995; chief executive officer and chair, KinderCare Learning Centers, Inc., 1995–1997, director, 1997–1999

Concurrent Positions: visiting associate professor, Bryn Mawr College, 1969; fellow, Center for Advanced Studies in the Behavioral Sciences, Stanford University, 1976–1977; visiting professor, Gothenburg, Stockholm, and Uppsala Universities, Sweden, 1993–1994

Sandra Scarr is renowned for her research on how genetics, psychology, and environment can inform public policy debates. Her research interests include genetic variability in human behavior, particularly intelligence and personality, and the effects of variation in the quality of home and childcare environments on children's development. She has investigated how the family influences personality development, intelligence, and school achievement, and what effects interventions such as preschool programs have on children. She is considered an expert on daycare systems and adoption with her studies on the correlation between environment and intelligence. Scarr attracted national attention with her research on controversial topics such as daycare, racial differences in IQ and school performance, and the effects of lead exposure on the IQs of children.

Scarr became interested in child development as an undergraduate studying sociology at Vassar in the 1950s, at a time when the subject was only beginning to garner serious intellectual consideration. After graduation, she worked for social service agencies, where she began to differentiate between the psychological and economic needs of different client groups. She went on to study psychology in graduate school at Harvard and, in 1967, began researching why black children perform so poorly in school and on intelligence tests. After 10 years of research, she concluded that such performance was owing to sociocultural disadvantage; her work was published as *Race, Social Class, and Individual Differences in IQ* (1981). As a career woman with four children, she combined her background in child development with research on daycare to develop expertise on the controversial subject. Recognizing that childcare is an important social and economic necessity that allows women to participate in the labor force, she argued against the concern that childcare may have an adverse effect on the emotional development of children, looking at the role of parental attachment and anxiety over separation. Her book, *Mother Care/Other Care* (1984), received the National Book Award of the American Psychological Association, and she has published

hundreds of articles and reviews on the topic. In the mid-1990s, she was chief executive officer and then director of a national childcare chain, KinderCare.

Scarr's awards and recognitions include the Distinguished Contribution to Research on Public Policy of the American Psychological Association (1988), James M. Cattell Award of the American Psychological Society (1993), and Dobzhansky Award for Lifetime Achievement from the Behavior Genetics Association. She is a fellow of the American Association for the Advancement of Science and American Academy of Arts and Sciences, and a member of the American Psychological Association, Behavior Genetics Association (president, 1985–1986), and Society for Research in Child Development (president, 1989–1991), and a founding member of the American Psychological Society (president, 1996). She is identified in some sources as Scarr-Salapatek.

Further Resources

O'Connell, Agnes N. and Nancy Felipe Russo, eds. 2001. *Models of Achievement: Reflections of Eminent Women in Psychology*. Vol. 3. Mahwah, NJ: Lawrence Erlbaum Associates.

Scharrer, Berta Vogel

1906–1995

Neuroendocrinologist

Education: Ph.D., zoology, University of Munich, 1930

Professional Experience: assistant, Research Institute of Psychiatry, University of Munich, 1932–1934; guest investigator, Neurological Institute, Frankfurt, 1934–1937; guest investigator, Department of Anatomy, University of Chicago, 1937–1938; guest investigator, Rockefeller Institute, 1938–1940; senior instructor, Western Reserve University, 1940–1946; instructor to assistant professor, University of Colorado, 1946–1954; professor, anatomy, Albert Einstein Medical College, 1955–1995

Concurrent Positions: Guggenheim fellow, 1947–1948

Berta Scharrer and her husband, Ernst Scharrer, pioneered the research on neurosecretion that helped to create a new discipline in physiology, that of neuroendocrinology. Neurosecretion is the theory that nerves secrete hormones into the blood. Among the most important of the couple's findings was the discovery that, in both mammals and insects, there were two completely analogous

neuroendocrine organ systems, each of which controlled a variety of non-nervous processes. Her other research interests included comparative endocrinology, ultrastructure, and neuroimmunology. Berta Scharrer concentrated on invertebrates while her husband studied vertebrates and, therefore, even though they worked together, they produced few joint publications. Although she held several prestigious research positions at institutions in the United States and Europe, due to anti-nepotism rules, she was unable to obtain a full-time faculty appointment until the couple joined the Albert Einstein Medical College. In several interviews, Scharrer said the situation was to her advantage because she could concentrate on research without the burden of administrative responsibilities and pressure to publish. Scharrer remained at Albert Einstein for 40 years, formally retiring just months before her death in 1995.

Scharrer was elected to the National Academy of Sciences in 1967. She received honorary degrees from eight universities and numerous awards, including the Kraepelin Gold Medal Award (1978), the Koch Award (1980), the Henry Gray Award (1982), the Schleiden Medal (1983), and the National Medal of Science from the National Science Foundation (1983). She was elected president of the American Association of Anatomists (1978–1979), and was an honorary member of the American Society of Zoologists and the International Society of Neuroendocrinology. She was a member of the American Academy of Arts and Sciences and several German and other European scientific academies.

Further Resources

Purpura, Dominick P. 1998. "Berta V. Scharrer. December 1, 1906 July 23, 1995." *Biographical Memoirs*. 74: 288–307. Washington, D.C.: National Academy Press. http://books.nap.edu/openbook.php?record_id=6201&page=288.

Schwan, Judith A.

1925–1996

Chemical Engineer

Education: B.S., chemical engineering, University of Cincinnati, 1948; M.S., physical chemistry, Cornell University, 1950

Professional Experience: research chemist to senior chemist, Emulsion Research Division, Eastman Kodak Laboratories, 1950–1965, laboratory head, 1965–1968, assistant director, 1968–1971, director, 1971–1975, assistant director, Kodak Research and Development Laboratories, 1975–1987

Judith A. Schwan was a chemical engineer who helped develop new types of film during her more than 35-year career at Eastman Kodak Laboratories in Rochester, New York. She eventually received more than 20 patents for her new research processes and development of new products related to Kodachrome and Kodacolor brand color negative films, print films, and Ektachrome motion picture films. Schwan was part of a generation of women who entered into engineering during the post–World War II boom in technological and scientific careers. She completed her undergraduate work at the University of Cincinnati, and went on to graduate school at Cornell University in New York, where she majored in physical chemistry and took numerous courses in chemical engineering. She began working on new product development at the Kodak Emulsion Research laboratory immediately after receiving her master’s degree in 1950. She rose to senior research chemist and laboratory head, and held a variety of management positions, including assistant director and director of the Research and Development Laboratories.

Schwan was elected to the National Academy of Engineering in 1982. She received a Distinguished Alumnus Award from the University of Cincinnati, the Athena Award of Rochester, New York Chamber of Commerce, and the Technicolor-Herbert T. Kalmus Gold Medal Award of the Society of Motion Picture Engineers (1979). She was on the council of the Industrial Research Institute (1979–1981) and was a member of the Society of Motion Picture and Television Engineers, American Chemical Society, and Society of Photographic Scientists and Engineers.

Further Resources

Thomas, Leo J. 2002. “Judith A. Schwan. 1925–1996.” *Memorial Tributes: National Academy of Engineering*. 10: 206–209. Washington, D.C.: National Academy Press. http://books.nap.edu/openbook.php?record_id=10403&page=206.

Schwarzer, Theresa Flynn

b. 1940

Geologist, Petroleum Geologist

Education: B.S., Rensselaer Polytechnic Institute, 1963, M.S., 1966, Ph.D., geology, 1969

Professional Experience: instructor, geology, State University of New York at Albany, 1969; research fellow, Rice University, 1969–1972; senior research

geologist, Exxon Company, 1972–1974, research specialist, 1974–1976, senior research specialist, 1976–1978, senior explorer geologist, Gulf Coast Division, Exxon USA, 1978–1980, project leader, Texas Offshore Division, 1980–1981, district production geologist, East Texas Division, 1981–1983, senior supervisor, Exxon Production Research Company, 1983–1987, geological advisor, Exxon USA, 1987–

Theresa Schwarzer is a geologist who has been recognized for her expertise in petroleum exploration. Her research interests include inorganic and organic geochemistry; remote sensing; multivariate statistical techniques; and interpretation and integration of geophysical, geological, and geochemical data for hydrocarbon exploration. For more than 35 years, she has worked for Exxon Corporation in increasing levels of responsibility for research in hydrocarbon exploration. Among her achievements are the discovery of commercial oil and gas deposits, and research on and development of unconventional exploration methods. As a geologist, she relies upon detailed maps, soil and rock analyses, soundings, and other details to conduct remote sensing of a potential site for exploration. Diminishing energy, mineral, and water resources, and increasing environmental and political concerns over drilling for oil, have placed a premium on the unique qualifications of geoscientists.

Schwarzer served as chair of the women geoscientists committee of the American Geological Institute from 1973 to 1977. She is a member of the Geological Society of America, American Association of Petroleum Geologists, Society for Exploration Geo-Physicists, and Geochemical Society.

Scott, Juanita (Simons)

1936 2001

Developmental Biologist

Education: A.A., Clinton Junior College, 1956; B.S., biology, Livingstone College, North Carolina, 1958; M.S., biology, Atlanta University, 1962; Ed.D., science education, University of South Carolina, 1979

Professional Experience: high school teacher, 1958–1960; instructor, biological science, Benedict College, 1963–1964; instructor, Morris College, 1965–1967; assistant to associate professor, Benedict College, 1968–1981, professor, 1981–1987, head, Division of Mathematics and Natural Sciences, 1987–1994, head, Department of Biological and Physical Science, 1992–1994, dean, Division of Arts and Sciences, 1994–2001

Juanita Scott was a developmental biologist known for her research on problems of water pollution in the rivers and streams of South Carolina. She started her research in the late 1960s on the pollutants being dumped into the waters by industrial firms, and by the mid-1980s, she had become interested in the microscopic characteristics of individual cells. She studied how pollutants, such as lead, cadmium, and mercury, act on different structures within a cell. Her research indicated that parts of a frog's skin cells are more likely to react to metal contamination than other parts of the skin cells. She and her team of student researchers found that a frog's skin not only repels some toxic compounds but also has some antibiotic properties. After receiving a doctorate in science education from the University of South Carolina in 1979, Scott did additional postdoctoral studies in biology, microbiology, and human sexuality at North Carolina State University, Columbia College, Clark College, and New York University, continuing her own research and publishing papers on environmental and cellular biology. She began teaching biology at Benedict College in Columbia, South Carolina, in 1963 and spent her entire career there in various teaching and administrative positions, including overseeing 10 academic departments as dean of the Division of Arts and Sciences.

Scott grew up on a farm near Columbia, South Carolina, that had no running water or electricity. Although there were 15 children in the family, her parents placed great emphasis on education. She graduated from high school at 16 and, although she did not have any particular ambition to be a scientist, had a good capacity for learning and did particularly well in her science courses. Influenced by her biology teacher, she decided to major in biology at Livingstone College, but also completed the courses for a teaching certificate. She then taught in a high school that, although it was relatively new, was segregated and not well-funded; for instance, there was no scientific equipment available in the laboratory.

After becoming a college instructor and administrator, she remained concerned about the quality of science teaching in middle and junior high schools, and found that many students arrived at college or university with little knowledge of the sciences and frequently had the attitude that all science courses were too hard. She developed summer science project workshops for middle school students (now operating as the Juanita S. Scott Middle School Summer Enrichment Program [MSSEP]), and worked with elementary and high school teachers under a National Science Foundation grant to develop math, science, and technology curricula, and improve the quality of instruction at each level by assuring that teachers understand the basic scientific concepts. For several years, she was involved with directing research, teaching biology, and conducting in-service training classes for teachers.

Further Resources

Benedict College. “Juanita Simons Scott, Ed.D.” http://www.benedict.edu/news/accomplishments/bc-news-faculty_n_staff_accomplishments-juanita_simons_scott-20070515.html.

Seddon, Margaret Rhea

b. 1947

Physician, Astronaut

Education: B.A., physiology, University of California, Berkeley, 1970; M.D., University of Tennessee, 1973

Professional Experience: general surgery resident; medical doctor with a specialty in medical nutrition; astronaut program, National Aeronautics and Space Administration (NASA), 1978–1997; Assistant Chief Medical Officer, Vanderbilt University Medical Center, Nashville, Tennessee, 1997–2007; patient safety expert, Lifewing Partners LLC, 2007–

Margaret Rhea Seddon is a physician and retired astronaut who flew on three space shuttle flights. She was one of the six women who were first selected for the NASA astronaut program in 1978. She was the first woman to complete her training in 1979, but when plans for the first shuttle program were near completion, she learned she was pregnant and was unable to begin the training program; it was **Sally Ride** who became the first woman astronaut in space in 1983. Seddon was assigned to later missions as a payload specialist, launch-and-rescue helicopter physician, technical assistant to the director of flight-crew operations, and member of the Aerospace Medical Advisory Committee. While at NASA, she also worked part-time, when possible, as an emergency-room physician. All together, she logged more than 700 hours in space on three different missions (STS 51-D *Discovery* [1985], STS-40 *Columbia* [1991], and STS-58 *Columbia* [1993]); on these missions, she conducted experiments on the effects of gravity and on the effects of space flight on the cardiovascular, metabolic, musculoskeletal, and other systems. She retired from NASA in 1997.

After leaving NASA, Seddon became Assistant Chief Medical Officer at Vanderbilt University Medical Center (VUMC) in Tennessee. She was terminated from Vanderbilt in 2007 and subsequently filed a (still-pending) gender-discrimination lawsuit, claiming that VUMC “has not made a concerted effort . . . to recruit, encourage and attract high-level female physicians to key clinical

leadership positions.” Seddon also claims she did not receive supplemental pay as a faculty member, as did male colleagues in the same position. Seddon currently works with Lifewing Partners LLC, which provides patient-safety training to hospitals. Her work has been profiled in mainstream newspapers and magazines, and her research published in medical journals such as the *Journal of the American College of Surgeons* and the *American Journal of Clinical Nutrition*.

A recipient of many NASA and scientific awards, Seddon was named a Laurel Legend for her lifetime contributions to aviation by *Aviation Week and Space Technology* magazine in 2004, and in 2005, she was inducted into the Tennessee Aviation Hall of Fame.

Further Resources

Kevles, Bettyann H. 2003. *Almost Heaven: The Story of Women in Space*. New York: Basic Books.

National Aeronautics and Space Administration. “Margaret Rhea Seddon (M.D.).” <http://www.jsc.nasa.gov/Bios/htmlbios/seddon.html>.

Edgemon, Erin. 2008. “Ex-Astronaut Files Suit against Vanderbilt Medical Center.” *Murfreesboro Post*. (19 August 2008). <http://www.murfreesboropost.com/news.php?viewStory=12539>.

Sedlak, Bonnie Joy

b. 1943

Cell Biologist, Developmental Biologist

Education: B.A., Northwestern University, 1965; M.A., Case Western Reserve University, 1968; Ph.D., biology, Northwestern University, 1974

Professional Experience: instructor, biology, Northwestern University, 1971–1972; research associate, biochemistry, Rush Medical College, 1974–1975; assistant professor, biology, Smith College, 1975–1977; assistant professor, biology, State University of New York, Purchase, 1977–1981; associate research scientist, University of California, Irvine, 1981–1985; sales representative, North American Science Associates, Irvine, 1986–1987; program manager, Microbics Corporation, 1987–1988; sensor analyst, Fritzsche, Pambianchi Associates, 1988–1990; biotechnology consultant, 1990–1991; business development and licensing manager, Becton Dickinson Advanced Cellular Biology, 1991–1992; licensing officer for technical transfer, University of California, Alameda, 1992–1994; independent consultant, 1994–

Bonnie Sedlak is a cell biologist whose early research focused on using the electron microscope to study cellular aspects of development and endocrine control in insects. She left research and teaching to work in industry as a business development and licensing manager and biotechnology consultant. Her clients have included healthcare research companies as well as universities and industry involved in medical and technical engineering. She received a doctorate in biology in 1974 and, after teaching and conducting research at several universities, accepted a position as a sales representative for North American Science Associates. She eventually worked in several locations as a licensing manager, overseeing the patent process for research and negotiating license agreements with companies, government agencies, and other universities in order to move research findings to marketable products.

Sedlak is a member of the American Society for Cell Biology, American Association for the Advancement of Science, Society for Developmental Biology, and Electron Microscopy Society of America.

Seibert, Florence Barbara

1897–1991

Biochemist

Education: A.B., Goucher College, 1918; Ph.D., physiological chemistry, Yale University, 1923

Professional Experience: chemist, Hammersley Paper Mill, 1918–1920; instructor, pathology, University of Chicago, and assistant, Sprague Memorial Institute, 1924–1928, assistant professor, biochemistry, 1928–1932; assistant to associate professor, Henry Phipps Institute, University of Pennsylvania, 1932–1955, professor, 1955–1959; director, cancer research laboratory, Mound Park Hospital Foundation, 1964–1966

Concurrent Positions: Guggenheim fellow, Sweden, 1937–1938; visiting lecturer, various schools, 1946–1948

Florence Seibert was a biochemist who purified the tuberculin PPD that is used worldwide in skin tests to detect tuberculosis, or TB. Her research interests also included intravenous therapy and blood transfusions, and the isolation of specific bacteria to give some immunity in cancer. After receiving her undergraduate degree from Goucher College, she originally considered medical school, but a professor helped her get a job as a chemist for a paper mill, possibly due to the

shortage of male chemists during World War I. She returned to school to continue her graduate studies at Yale, where she received her doctorate in 1923. At Yale, her main breakthrough was development of a distillation method for removal of bacteria that could contaminate protein solutions used in blood transfusions. Previously, persons receiving such medical interventions were at high risk of infections and fevers due to bacteria. She held a postdoctoral fellowship at the University of Chicago that led to an instructorship in pathology, then a faculty position in biochemistry. At Chicago, she developed her method for purifying the proteins used in the TB test, which not only protected patients, but provided better diagnostic results. She was also affiliated with the Sprague Memorial Institute, and her work was supported with funds from the National Tuberculosis Association (now the American Lung Association). Her method was later adopted as the standard by the World Health Organization.



Biochemist Florence Seibert, ca. 1948. She developed the protein substance used for the tuberculosis skin test. (National Library of Medicine)

In 1932, Seibert followed her mentor and collaborator and accepted a faculty position in biochemistry at the University of Pennsylvania. In 1937, she spent a year conducting research at the University of Upsala in Sweden, under a prestigious Guggenheim fellowship. Despite her continued achievements in improving the existing tuberculin skin test, she did not advance to full professor until 1955. Even after her formal retirement in 1959, she continued her research and volunteer activities on behalf of cancer research. In 1968, she published an autobiography, *Pebbles on the Hill of a Scientist*. She lived most of her life with her sister, Mabel, who served as her longtime research assistant.

Seibert was the author or co-author of dozens of scientific papers and articles. She was the recipient of five honorary degrees, as well as the Trudeau Medal from the National Tuberculosis Association (1938), the Garvan Medal of the American Chemical Society (1942), the Gimbal Award (1945), the Scott Award (1947), and the John Eliot Memorial Award of the American Association of Blood Banks

(1962). She was also a member of the American Association for the Advancement of Science. In 1990, she was inducted in the National Women's Hall of Fame.

Semple, Ellen Churchill

1863–1932
Geographer

Education: A.B., Vassar College, 1882, A.M., 1891; University of Leipzig, 1891–1892, 1895

Professional Experience: founder and teacher, Semple Collegiate School, 1893–1895; lecturer, geography, University of Chicago, 1906–1920 (intermittently); lecturer, anthropogeography Clark University, 1921–1923, professor, 1923–1932

Concurrent Positions: lecturer, Oxford University, 1912, 1922; Wellesley College, 1914–1915; University of Colorado, 1916; Columbia University, 1918

Ellen Semple was recognized by her contemporaries as one of the outstanding geographers of her time. After attending the University of Leipzig, she and her sister opened a private school in which she taught history. She combined this experience with her interest in geography in her book, *American History and Its Geographic Conditions* (1903). The publication of this work resulted in invitations to teach in the new department of geography at the University of Chicago. Her second book, *Influences of Geographic Environment, on the Basis of Ratzel's System of Anthro-Geo-Geography* (1911), was viewed as one of the most scholarly books on geography at that time. A third book, published shortly before her death, was *The Geography of the Mediterranean Region: Its Relation to Ancient History* (1931).

After Semple received her undergraduate degree from Vassar in 1882, she returned home to teach in a private school. She opened her own school in 1893 after returning from Europe. Throughout her career, she rode into the backcountry of Kentucky to study the influence of geographic isolation on the life of the people there. Her research papers received favorable reviews. She taught off and on at the University of Chicago and also lectured at Oxford University, Wellesley College, the University of Colorado, and Columbia University. In 1921, she obtained a tenure-track faculty appointment at the new graduate department of geography at Clark University and was quickly promoted to professor. Semple received the Cullum Medal of the American Geographical Society (1914) and the Gold Medal of the Geographic Society of Chicago (1932). She received an honorary degree from the University of Kentucky in 1923, and in 1921, she was the first woman

to be elected president of the Association of American Geographers. She also was a member of the American Geographical Society.

Shalala, Donna Edna

b. 1941

Political Scientist

Education: B.A., Western College, 1962; M.S., Syracuse University, 1968, Ph.D., political science, 1970

Professional Experience: volunteer (Iran), Peace Corps, 1962–1964; graduate research fellow, Maxwell School of Citizenship and Public Affairs, Syracuse University, 1966–1968; lecturer, social science and assistant to dean, 1968–1970; assistant professor, political science, Bernard M. Baruch College, City University of New York, 1970–1972; associate professor and chair, Program in Politics and Education, Teachers College, Columbia University, 1972–1979; Assistant Secretary for Policy Development and Research, Housing and Urban Development (HUD), Washington, D.C., 1977–1980; professor, political science and president, Hunter College, 1980–1987; professor, political science and chancellor, University of Wisconsin, Madison, 1987–1993; Secretary, U.S. Department of Health and Human Services, 1993–2001; professor, political science and president, University of Miami, 2001–



Concurrent Positions: visiting professor, Yale Law School, 1976; co-chair, Advisory Commission on Consumer Protection and Quality in the Health Care Industry, 1996–

Political scientist Donna Shalala was appointed president of the University of Miami in 2001, after serving as Secretary of the Department of Health and Human Services under President Bill Clinton. (U.S. Department of Health and Human Services)

Donna Shalala occupied one of the most influential offices in Washington, D.C., as Secretary of the U.S. Department of Health and Human Services under President Bill Clinton between 1993 and 2001. The agency is one of the largest in government and has one of the largest budgets, including funds for scientific research. In that capacity, she oversaw some of the most important government departments related to public health and policy, such as the National Institutes of Health, Centers for Disease Control, Food and Drug Administration, Social Security Administration, and the Indian Health Service, among others. One of her early actions was to escalate the budgets for cancer prevention at the National Cancer Institute and the Centers for Disease Control, with a special emphasis on breast cancer. She was concerned that women's issues were underfunded, underdiagnosed, and undertreated. Another of her goals was to shield scientific research from political pressure and excessive bureaucratic burdens. She also questioned the social values portrayed in many television programs and their effect on our society.

Shalala is a prominent political scientist who has held a variety of successful positions in both government and academic settings. She held professorships at several universities and is past president of Hunter College and chancellor of the University of Wisconsin, Madison, and is currently president of the University of Miami. Her first political position was as assistant secretary for policy development and research for HUD. During the early 1970s, she wrote four books: *Neighborhood Governance* (1971), *City and the Constitution* (1972), *Property Tax and the Voters* (1973), and *Decentralization Approach* (1974). She has been a member of the Committee on Economic Development (1991–1993), a member of the board of directors of the Institute of International Economics (1981–1993), a member of the Children's Defense Fund (1980–1993), and a trustee of the Brookings Institution (1989–1993). In 2006, she chaired the Committee on Maximizing the Potential of Women in Academic Science and Engineering, which investigated the absence and obstacles to women in high-level research positions in the sciences. In 2007, she was called upon by President George W. Bush to head a commission investigating allegations about conditions at Walter Reed Army Medical Center. Shalala received the Distinguished Service Medal of Teachers College, Columbia University, in 1989. She is a member of the American Political Science Association, American Society for Public Administration, and National Academy of Public Administration.

Further Resources

University of Miami. "President Donna E. Shalala's Biography." http://www.miami.edu/index.php/about_us/leadership/office_of_the_president/president_donna_e_shalalas_biography/.

Shapiro, Lucille (Cohen)

b. 1940

Molecular Biologist

Education: B.A., Brooklyn College, 1962; Ph.D., molecular biology, Albert Einstein College of Medicine, 1966

Professional Experience: assistant to associate professor, molecular biology, Albert Einstein College of Medicine, 1967–1977, professor, 1977–1986; Eugene Higgins Professor and chair, microbiology, College of Physicians and Surgeons, Columbia University, 1986–1989; Joseph D. Grant Professor and chair, developmental biology, School of Medicine, Stanford University, 1989–; co-founder and director, Anacor Pharmaceuticals, 2002–

Lucille “Lucy” Shapiro has had a distinguished career as a molecular biologist working on the genetics and biochemistry of the bacterial cell cycle and unicellular differentiation. After receiving her doctorate at Albert Einstein College of Medicine, she continued on as an assistant professor and rose through the ranks



Molecular biologist Lucille Shapiro. (Courtesy of the Stanford University News Service Library)

to full professor. She remained at Albert Einstein for 20 years before becoming professor and chair of microbiology at Columbia University. In 1986, she moved to Stanford in California, where she has served as chair and now director of the Beckman Center for Molecular and Genetic Medicine. In 2002, she co-founded Anacor Pharmaceuticals, a biopharmaceutical company developing new antimicrobial treatments for bacterial and fungal diseases and infections.

Shapiro's research has been published in numerous medical journals, including *Journal of Bacteriology*, *Journal of Molecular Biology*, *Cell*, *Molecular Biology of the Cell*, *Trends in Genetics*, and *Science*, and she has been a distinguished lecturer at a number of universities. Her expertise has been sought as a board member and scientific advisor in academia, government, and corporate settings, including for G. D. Searle Company, Massachusetts General Hospital, SmithKline Beecham, the Helen Hay Whitney Foundation, Whitehead Institute of the Massachusetts Institute of Technology, Harvard University, Howard Hughes Medical Institute, the president's council of the University of California, Silicon Graphics, Inc., and, most recently, Gen-Probe, a medical research company in San Diego. She has twice served as an American Cancer Society Established Investigator and was a nonexecutive director of GlaxoSmithKline (2001–2006).

Shapiro was elected a member of the Institute of Medicine of the National Academy of Sciences in 1991. She has received numerous awards, including the Alumna Award of Honor of Brooklyn College (1983), an Excellence in Science Award of the Federation of American Societies for Experimental Biology (FASEB) (1994), and the Selman Waksman Award of the National Academy of Sciences (2005). She is a fellow of the American Association for the Advancement of Science, the American Philosophical Society, and the California Council on Science and Technology (CCST), and a member of the American Society of Biochemistry and Molecular Biology, American Society for Microbiology, American Society for Cell Biology, Genetics Society of America, and New York Academy of Sciences.

Further Resources

Stanford University. Faculty website. http://med.stanford.edu/profiles/devbio/faculty/Lucille_Shapiro/.

Anacor Pharmaceuticals. <http://www.anacor.com/>.

Shaw, Jane E.

b. 1939

Physiologist, Clinical Pharmacologist

Education: B.S., University of Birmingham, England, 1961, Ph.D., physiology, 1964

Professional Experience: staff scientist, Worcester Foundation for Experimental Biology, 1964–1970; senior scientist, Alza Research, 1970–1972, principal scientist, 1972–; president, Alza Research Division, and chair of the board, Alza Ltd., 1985, executive vice president, Alza Corporation, 1985–1987, president and chief operating officer, 1987–1994; founder and consultant, Stable Network, 1994–; chair and chief executive officer, Aerogen, Inc. (now Nektar Therapeutics), 1998–2005; chairman of the board, Intel, 2009–

Concurrent Positions: director and committee chair, McKesson Corporation, 1992–; nonexecutive chairman and committee chair, Intel Corporation, 1993–; director, OfficeMax, 1994–2006; director, Talima Therapeutics, Inc.

Jane Shaw is renowned for research that led to the development of transdermal drug patches, such as those used for motion sickness. Her research includes elucidation of the physiological role of the prostaglandins, mechanism of action of analeptics, mechanism of gastric secretion, and physiology and pharmacology of the skin. As a graduate student at the University of Birmingham, England, she worked with Peter Ramwell identifying prostaglandins. After graduation, she and several other members of the research team followed Ramwell to the Worcester Foundation for Experimental Biology in Massachusetts, part of the much-publicized brain drain in England in the 1960s.

In 1970, she was invited to join Alza Corporation, a private company that manufactures pharmaceutical products and conducts commercial research and development on drug-delivery systems for human and veterinary use. Shaw holds several patents for technology that allows a patient to absorb a prescription drug through the skin from a bandage-like patch. Transdermal therapeutic systems for drug delivery are advantageous in chronic conditions such as hypertension because patients may forget to take medication when they have no symptoms. They are also advantageous when medications have to be given very frequently. Beginning as senior scientist, she moved quickly through the ranks to become president of the research division, executive vice president of Alza Corporation and board chair of the parent company, Alza Ltd., and then president and chief operating officer until 1994. She next founded her own biopharmaceutical firm, Stable Network, and served as a consultant. Between 1998 and her retirement in 2005, she served as chief executive officer at Aerogen, Inc. (now Nektar Therapeutics), a firm that develops drug-delivery devices for respiratory ailments. Shaw personally holds several patents in this area of research.

Shaw has consulted for numerous pharmaceutical research companies and has been a savvy businesswoman as well, serving on the boards of corporations such as OfficeMax and, most recently, chair at computer semiconductor manufacturer, Intel. She has published more than 100 professional articles and received an

honorary doctorate from Worcester Polytechnic Institute in 1992. She is a member of the American Association for the Advancement of Science, New York Academy of Sciences, American Physical Society, American Society of Clinical Pharmacology and Therapeutics, American Association of Pharmaceutical Scientists, and American Pharmaceutical Association.

Shaw, Mary M.

b. 1943

Computer Scientist

Education: B.A., mathematics, Rice University, 1965; Ph.D., computer science, Carnegie-Mellon University, 1971

Professional Experience: systems programmer and researcher (part-time), Rice University Computer Project, 1962–1968; assistant professor, computer science, Carnegie-Mellon University, 1972–1977, senior research computer scientist, 1977–1982, associate professor, 1982–1986, chief scientist, Software Engineering

Institute, 1984–1987, professor, 1986–, Alan J. Perlis Professor of Computer Science, 1995–

Concurrent Positions: member, Human Computer Interaction Institute, Carnegie-Mellon University, 1994–, fellow, Center for Innovation and Learning, 1997–1998, member scientist, Institute for Software Research, 1999–, co-director, Sloan Software Industry Center, 2001–2006

Mary Shaw is a renowned expert in computer software and a leading proponent of developing software engineering as a discipline. Her research includes software architecture, programming language design, abstraction techniques for advanced programming, software engineering, and computer-science education.



Computer scientist Mary Shaw. (Courtesy of the Carnegie Mellon University)

She has made major contributions to the analysis of computer algorithms as well as to abstraction techniques for advanced programming methodologies, programming language architecture, evaluation methods for software, performance and reliability of software, and software engineering. She developed computer programs called “abstract data types” as a method for organizing the data and computations used by a program so that related information is grouped together, and she created a programming language called “Aphard” that implemented those abstract data types. She thus made programs more user-friendly for the scientists who are using them to manipulate their research data.

Shaw grew up during the Cold War era of scientific and technological advances, and her father, a civil engineer and government economist, encouraged her interests in science and math. As a high school student, she participated in an after-school program that included a visit to an International Business Machines (IBM) facility and introduction to an early IBM computer program. For several summers during high school, Shaw worked at the Research Analysis Corporation of the Johns Hopkins University Operation Research Office, which gave her the opportunity to explore fields outside the normal school curriculum. Although there were no courses in computer science when she attended Rice University, she found a small group called the Rice Computer Project that had built a computer, the Rice I, under the direction of an electrical engineering faculty. Shaw joined the group and worked on a programming language, writing subroutines and studying how to make an operating system run more rapidly. She received her undergraduate degree in mathematics at Rice and went on to study computer science at Carnegie Mellon in Pennsylvania. After receiving her doctorate in 1971, she joined the faculty as the first female member of the Computer Science Department.

Shaw has been instrumental in developing innovative undergraduate and graduate computer-science curricula and degree programs. She was one of the early scientists to see the need for software engineering as a separate discipline. She even helped develop a curriculum for IBM to offer its own employees and founded the Software Engineering Institute at Carnegie Mellon. She has contributed to several books and published hundreds of scientific papers and reports.

For her contributions to software and systems development and education, Shaw has received the Warnier Prize (1993), the Stevens Award (2005), the Software Engineering Institute Award of Excellence (2006), and the Nancy Mead Award for Excellence in Software Engineering Education (2010). She is a fellow of the Association for Computing Machinery (ACM), the Institute for Electrical and Electronics Engineers (IEEE), and the American Association for the Advancement of Science (AAAS), and a member of the New York Academy of Sciences and the International Federation of Information Processing Societies (IFIPS).

Further Resources

Carnegie Mellon University. Faculty website. <http://spoke.compose.cs.cmu.edu/shaweb/>.

Sherman, Patsy O'Connell

1930 2008

Chemist

Education: B.A., Gustavus Adolphus College, 1952

Professional Experience: chemical researcher, Minnesota Mining and Manufacturing (3M), 1952–1992

Patsy Sherman was a chemist who, along with colleague Sam Smith, invented Scotchgard Fabric Protector, a moisture and stain repellent, while employed at 3M in the 1950s. The discovery of the substance was largely by accident, when someone in the lab spilled a new latex material onto a shoe and Sherman discovered it could not be washed off. She began to think of new possible applications for such a waterproof material, along with her supervisor, Smith, and in 1955, Sherman and Smith introduced Scotchgard, a protective coating for fabrics and other materials. Sherman began working for 3M immediately after graduating from college and remained there for 40 years, until her retirement in 1992. She rose through the ranks from research specialist to manager of the chemical resources division to head of technical development, and held several patents for fluorochemical polymers and processes.

The Scotchgard product made 3M a household name and earned the company millions of dollars, but in 2002 it was announced that 3M would remove Scotchgard from the market over environmental concerns. The property that made its chemical makeup attractive as a fabric protector, its insolency or inability to be broken down, also made it potentially dangerous. Although tests of potential toxicity to humans and to the water supply remain inconclusive, elevated levels of perfluorochemicals have been found in the blood of company employees as well as in studies of certain animal species. In light of this research, 3M chose to exercise what they called “responsible environmental management” in phasing out the current chemical process used to create Scotchgard products. The product is still available as the company experiments with alternative formulas, and government organizations will continue to monitor the potential environmental and health effects of perfluorochemicals.

Sherman was committed to science education and was often an invited speaker to serve as a role model for young students. She received the Joseph M. Biedenbach

Distinguished Service Award of the American Society for Engineering Education in 1991. In 2001, she was inducted into the National Inventors Hall of Fame, one of only a handful of women to be acknowledged, and in 2002, she was one of 37 inventors who appeared at a celebration of the 200th anniversary of the U.S. Patent and Trademark Office. She was a longtime member of the American Chemical Society.

Shields, Lora Mangum

1912–1996

Biologist

Education: B.S., biology, University of New Mexico, 1940; M.S., 1942; Ph.D., botany, University of Iowa, 1947

Professional Experience: associate professor, biology, New Mexico Highlands University, 1947–1954, professor and department head, 1954–1978, director, Environmental Health Division, 1971–1978; researcher and visiting professor, Navajo Community College, Shiprock, New Mexico, 1978–retirement

Lora Shields was been recognized for her research on the effects of nuclear bomb testing on Southwestern plants and vegetation, and the human health hazards from mining uranium. She was the first Native American (Navajo) to receive a doctorate in botany. She studied at the University of New Mexico, and after receiving her Ph.D. from the University of Iowa, she returned to New Mexico as associate professor of biology at New Mexico Highlands University. She was promoted to full professor and department head in 1954, and named director of the Environmental Health Division in 1971. A few years later, she took a position as appointed researcher and visiting professor at Navajo Community College. By the 1970s, the U.S. government was mining uranium almost exclusively from Southwestern Native American lands, and Shields was committed to examining the health and environmental impact of this development. Her research focused on nuclear effects on vegetation, birth anomalies in the Navajo uranium district among miners and other inhabitants, effects of radiation exposure on plants, and streptococcal disease among the Navajo Indian population. Her work was supported by grants from the National Institutes of Health, National Science Foundation, March of Dimes Birth Defects Foundation, and Minority Biomedical Research Support, among others. She also received research grants from some of the agencies that recently declassified data regarding the effects of nuclear testing on humans, such as the Atomic Energy Commission, and from pharmaceutical companies.

Dedicated to science education at all levels, Shields was involved throughout her career with the New Mexico Academy of Science (NMAS) as secretary-treasurer (1951–1953), president (1954), and recipient of the NMAS Distinguished Scientist Award (1965); she also served as state representative to the National Association of Academies of Science (1960–1984) and became president of the NAAS (1976). For many years, she was editor of the *New Mexico Journal of Science*. She was a member of the American Association for the Advancement of Science and the Ecological Society of America.

Shipman, Pat

b. 1949

Paleoanthropologist

Education: B.A., Smith College, 1970; M.A., New York University, 1974, Ph.D., anthropology, 1977

Professional Experience: visiting lecturer, anthropology, Jersey City State College, 1974; adjunct instructor, Fordham University, 1975; editor and research associate, American Institutes for Research, 1976–1978; associate research scientist, Department of Earth and Planetary Sciences (joint appointment, Department of Cell Biology and Anatomy), Johns Hopkins University, 1978–1981, assistant professor, cell biology and anatomy, 1981–1986, assistant dean, Academic Affairs, School of Medicine, 1985–1990, associate professor, 1986–1995; independent author, 1990–

Concurrent Positions: editor, *Anthroquest*, 1990–1992; adjunct professor, biological anthropology, Pennsylvania State University, 1995–

Pat Shipman is a paleoanthropologist who spent many years in Kenya as a research scientist, excavating paleontological and archaeological sites, and examining fossils stored there. Her research focused on trying to deduce the environmental context in which our earliest ancestors evolved and what their lifestyles and adaptations were like. She is particularly interested in the history of science and how scientific information is used. She is the co-author of *The Neandertals: Changing the Image of Mankind* (1993), which focuses on how the interpretations of these finds have fluctuated through the gradual accumulation of information on both the anatomical characteristics and the geographical distribution of the remains. The central theme is how scientific opinion on the Neandertals has tended to shift between two extreme positions: the people who see them as being in the main course of human evolution, and those who see them as representing a sideline of human population.

Shipman's next book, *The Evolution of Racism: Human Differences and the Use and Abuse of Science* (1994), traces the attempts of scientists from the mid-nineteenth century to the present to grapple with the issues of race, from evolution, to eugenics, to intelligence testing and debates about immigration. In *Taking Wing: Archaeopteryx and the Evolution of Bird Flight* (1998), she draws on diverse scientific fields to give a comprehensive analysis of the ideas that explain how the adaptations needed for animal flight came about. Since leaving a full-time academic position in 1995, Shipman has been committed to bringing scientific information and debates to the general public. She has published on numerous scientific topics in popular science magazines and appeared on several television documentaries, such as "In Search of Human Origins" in 1997. In addition to her numerous articles, she has authored or co-authored more than 10 books on scientists and the history of the science, the most recent including *The Man Who Found the Missing Link: Eugene Dubois' Lifelong Quest to Prove Darwin Right* (2001), *To the Heart of the Nile: Lady Florence Baker and the Exploration of Central Africa* (2004), and *The Ape in the Tree: An Intellectual and Natural History of Proconsul* (with Alan Walker, 2005).

In 2005, the Center for Research into the Anthropological Foundations of Technology (CRAFT) and the Stone Age Institute at Indiana University acknowledged Shipman for her "lifetime contributions to paleoanthropology and taphonomy." She is a member of the American Association of Physical Anthropologists, Society for American Archaeology, American Society of Mammalogists, Society of Vertebrate Paleontology, and American Association for the Advancement of Science.

Further Resources

Pennsylvania State University. Faculty website. http://www.anthro.psu.edu/faculty_staff/shipman.shtml.

Shockley, Dolores Cooper

b. 1930

Pharmacologist

Education: B.S., pharmacy, Xavier University, Louisiana, 1951; M.S., pharmacology, Purdue University, 1953, Ph.D., pharmacology, 1955

Professional Experience: assistant, pharmacology, Purdue University, 1951–1953; assistant professor, pharmacology, Meharry Medical College, Nashville, Tennessee, 1957–1967, associate professor, 1967–

Concurrent Positions: Fulbright fellowship, University of Copenhagen, 1955–1956; visiting assistant professor, Albert Einstein Medical College, 1959–1962

Dolores Shockley is known for her research in pharmacology, which is the science dealing with research on the preparation, uses, and especially the effects of drugs. Her research interests are the consequences of drug action on stress, the effects of hormones on connective tissue, the relationship between drugs and nutrition, and the measurement of nonnarcotic drugs. When she entered undergraduate school, she planned to become a pharmacist and operate her own drugstore, but during college, her interest shifted to research. She was the first African American woman to earn a doctorate in pharmacology in the United States and the first black woman to earn any doctorate from Purdue. After completing postdoctoral research at the University of Copenhagen, Shockley returned to the United States as an assistant professor at Meharry Medical College, a historically black medical school in Nashville, Tennessee. At first, she was uncertain that she had made a wise choice because some of the men thought she was just working there temporarily, but she soon proved she was there to stay and became a respected member of the faculty. She was promoted to associate professor in 1967, and later served as chair of the departments of microbiology and of the graduate program in pharmacology, the first African American woman to chair a department of pharmacology in the United States.

Shockley's awards and honors include the Lederle faculty award (1963–1966), and she was named Distinguished Alumni at the Purdue University School of Pharmacy and Pharmaceutical Sciences (2009). She is a member of the American Pharmaceutical Association and the American Association for the Advancement of Science. Vanderbilt University School of Medicine designated the Dolores C. Shockley Lectureship and Mentoring Award in her honor.

Further Resources

Jordan, Diann. 2006. *Sisters in Science: Conversations with Black Women Scientists on Race, Gender and Their Passion for Science*. West Lafayette, IN: Purdue University Press.

Shoemaker, Carolyn (Spellmann)

b. 1929

Planetary Astronomer

Education: B.A., Chico State College, 1949, M.A., history and political science, 1950

Professional Experience: visiting scientist, astrogeology, U.S. Geological Survey (USGS), Flagstaff, Arizona, 1980–; research professor, astronomy, Northern Arizona University, 1989–; staff member, Lowell Observatory, Flagstaff, 1993–

Concurrent Positions: research assistant, California Institute of Technology (CalTech), 1981–1985; guest observer, Mt. Palomar Observatory, 1982–1994

Carolyn Shoemaker has discovered more than 30 comets and 800 asteroids, more than any living astronomer. She first became known to the general public when the periodic comet Shoemaker-Levy 9 (named for Carolyn and husband, Gene Shoemaker, and their colleague David



Astronomer Carolyn Shoemaker has discovered more comets and asteroids than any living astronomer. (AP/Wide World Photos)

Levy) impacted on Jupiter in July 1994, and she was interviewed on television programs. However, she was already renowned in the scientific community because of the number of comets she had identified. Shoemaker uses the 18-inch Schmidt telescope at Mt. Palomar, ultra-fine-grain film, and a stereomicroscope. She worked with her husband, founder of the USGS Center for Astrogeology in Flagstaff, Arizona, in all of the discoveries except one, but he created the search program for comets and Earth-crossing asteroids that they used. Another area in which she has worked is in identifying Earth-approaching asteroids. For two weeks each month, during the dark of the moon, search teams gather at Mt. Palomar in California to track asteroids and meteorites that are close enough to impact the Earth. Such objects regularly fall to Earth throughout the world, and a large one could cause severe damage. Shoemaker has identified a record 500 asteroids, including 41 Earth-approachers.

Carolyn Shoemaker came to her scientific research later in life. Her husband was a world expert on impact craters, both on Earth and on other planets, and he trained the astronauts who landed on the moon in the basics of geology. Carolyn taught school, but after their own children were grown, she started accompanying her husband as an unpaid field assistant on his studies of craters on the Earth and then helped with his work surveying the moon. She got a position reviewing films of the night sky at

CalTech and soon became expert in identifying the tiny dark smudges on the films. She discovered her first comet in 1983, at the age of 54, without a degree in astronomy.

Shoemaker has received numerous honors, including a National Aeronautics and Space Administration (NASA) Exceptional Achievement Medal (1996), Woman of Distinction Award of the National Association for Women in Education (1996), and Distinguished Alumna of California State University, Chico (1996). With her husband Gene (who died in 1997 while on a research trip to Australia) she has been the co-recipient of the Rittenhouse Medal (1988) and the James Craig Watson Medal (1998); in 1995, the two were also named Scientists of the Year. She is the author of the report on Shoemaker-Levy 9 in the USGS *Yearbook* (1994), and her work has been featured in the media, such as on public television programs. She is a fellow of the American Academy of Arts and Sciences and a member of the Astronomical Society of the Pacific. She received an honorary doctorate from Northern Arizona University in 1990.

Further Resources

U.S. Geological Survey. "Carolyn Shoemaker." <http://astrogeology.usgs.gov/About/People/CarolynShoemaker/>.

Shotwell, Odette Louise

1922–1998

Organic Chemist

Education: B.S., chemistry, Montana State University, 1944; M.S., University of Illinois, 1946, Ph.D., organic chemistry, 1948

Professional Experience: teaching assistant, inorganic chemistry, University of Illinois, 1944–1948; research chemist, Northern Regional Research Laboratory, U.S. Department of Agriculture (USDA), 1948–1977, research leader, mycotoxin analysis and chemical research, 1975–1989

Concurrent Positions: consultant, Bureau of Veterinary Medicine, Food and Drug Administration, 1981–1986; consultant, Canadian Health and Welfare Department, 1983–1989; consultant and collaborator, USDA

Odette Shotwell was a chemist who made significant contributions to environmental science, and was recognized for her work in developing a cancer-producing toxin from molds. She held three patents, and her work led to or contributed to the development of several new antibiotics. Her research included synthetic

organic chemistry; the chemistry of natural products, including isolation, purification, and characterization; microbial insecticides; and mycotoxins. Her own father was a research entomologist and, in one instance, she conducted research on the chemistry of Japanese beetles as part of a government effort to stop the spread of the pests. Shotwell suffered from polio as a child and was confined to a wheelchair for most of her life. Still, she left home in Colorado to study chemistry at Montana State College (now University of Montana). She went on to pursue graduate studies at the University of Illinois and, after receiving her doctorate, joined the Northern Regional Research Laboratory of the USDA in Peoria, Illinois, in 1948. She was promoted to research leader in mycotoxin analysis and chemical research in 1975 and research leader in mycotoxin research in 1985, retiring from the agency (now known as the Northern Center for Agricultural Utilization Research) in 1989. Before and even after retirement, she consulted for the USDA and other government agencies in both the United States and Canada.

Among the awards Shotwell received were the Outstanding Woman Alumna of the Year from the city of Bozeman, Montana (1961), Outstanding Handicapped Federal Employee Award (1969), and Harvey W. Wiley Award of the American Oil Chemical Society (1982). She was elected a fellow of the Association of Official Analytical Chemists, and was a member of the American Association for the Advancement of Science, American Chemical Society, and American Association of Cereal Chemists.

Shreeve, Jean'ne Marie

b. 1933

Inorganic Chemist

Education: B.A., University of Montana, 1953; M.S., analytical chemistry, University of Minnesota, 1956; Ph.D., inorganic chemistry, University of Washington, 1961

Professional Experience: teaching assistant, chemistry, University of Minnesota, 1953–1955; assistant, University of Washington, 1957–1961; assistant professor, chemistry, University of Idaho, Moscow, 1961–1965, associate professor, 1965–1967, professor, 1967–1973, acting chair, Department of Chemistry, 1969–1970 and 1973, head of department and professor, 1973–1987, vice provost of research and graduate studies and professor, chemistry, 1987–

Jean'ne Shreeve is internationally known and nationally recognized for her contributions to the understanding of synthetic fluorine chemistry. Her research includes



Inorganic chemist Jean'ne Marie Shreeve.
(Courtesy of the University of Idaho)

synthesis of inorganic and organic fluorine-containing compounds. The major emphasis of her research has been the synthesis, characterization, and reactions of fluorine compounds that contain nitrogen, sulfur, and phosphorus. She and her students made a significant find when they discovered the compound perfluorourea, which is an oxidizer ingredient. She has also developed new synthetic routes to several important compounds, including chlorodifluoroamine and difluorodiazine. These compounds are used in synthesizing rocket oxidizers, but preparation by previously known techniques was hard to accomplish.

At the time she started her appointment at the University of Idaho, the chemistry department was poorly

equipped to support research. However, the state had just designated the campus at Moscow as Idaho's research university and had given it permission to grant doctoral degrees; because of her prominence in research, she was able to contribute to the growth of the chemistry department and its curriculum. She advanced rapidly through the ranks to full professor, head of the department, and then vice provost for research and graduate studies. She has devoted her life to educating other chemists, and she has drawn many exceptional students into graduate studies. Her own interest in chemistry developed when she was an undergraduate at the University of Montana because of an exceptional teacher.

Shreeve's work as a fluorine chemist earned her the 1972 Garvan Medal of the American Chemical Society (ACS) for outstanding achievements by American women chemists. The honor cited her contributions to the fundamental understanding of the behavior of inorganic fluorine compounds and to the synthesis of important new fluorochemicals. She has served on numerous committees in the ACS and the American Association for the Advancement of Science, and she has received numerous awards, including the Distinguished Alumni Award, University of Montana (1970); Outstanding Achievement Award, University of Minnesota (1975); Senior U.S. Scientist Award, Alexander Von Humboldt Foundation (1978); Fluorine Award of the ACS (1978); Excellence in Teaching

Award, Chemical Manufacturers Association (1980); and an honorary doctorate from the University of Montana (1982). She began serving on the board of Governors of Argonne National Laboratory in 1992. She is a fellow of the American Association for the Advancement of Science and a member of the American Chemical Society and American Institute of Chemists.

Further Resources

University of Idaho. Faculty website. <http://www.webpages.uidaho.edu/~jshreeve/>.

Simmonds, Sofia

1917–2007

Biochemist

Education: B.A., Barnard College, 1938; Ph.D., biochemistry, Cornell University, 1942

Professional Experience: assistant biochemist, medical college, Cornell University, 1941–1942, research associate, 1942–1945; instructor, physiological chemistry, School of Medicine, Yale University, 1945–1946, microbiologist, 1946–1949, assistant to associate professor, biochemistry and microbiology, 1949–1962, biochemist, 1962–1969, molecular biophysicist and biochemist, 1969–1975, professor; 1976–1988, lecturer and dean of undergraduate studies, 1990–1991

Sofia Simmonds has been recognized for her research on bacteria amino acid metabolism, in particular of the *E. coli* bacteria. She spent years in administrative posts at Yale's medical school, some of which continued after her retirement. After receiving her undergraduate degree from Barnard (the women's college of Columbia University) in 1938, she attended Cornell University, where she received her doctorate in biochemistry in 1942. She continued working there as a research associate until 1945 when she accepted an appointment as instructor of physiological chemistry in the school of medicine at Yale; she rose through the ranks at Yale, becoming a full professor in 1976. During her tenure there, she also served as associate dean and then dean of undergraduate studies, a position she continued even after formal retirement in 1988.

Simmonds's husband, Joseph S. Fruton, was also a biochemistry professor at Yale, and together they published *General Biochemistry* (1953), the first comprehensive textbook in the field. Their work has been reissued in several editions and has been translated into Japanese and several European languages. In 2005, the couple established the Joseph S. and Sofia S. Fruton Teaching and Research

Fund for the History of Science at Yale. After more than 70 years of marriage, the couple died within days of each other in July 2007.

Simmonds received the Garvan Medal of the American Chemical Society in 1969. She was also a member of the American Society of Biological Chemists.

Further Resources

“In Memoriam: Biochemists Joseph Fruton and Sofia Simmonds.” *Yale Bulletin & Calendar*. 36(2). (14 September 2007). <http://www.yale.edu/opa/arc-ybc/v36.n2/story22.html>.

Simon, Dorothy Martin

b. 1919

Physical Chemist

Education: A.B., chemistry, Southwest Missouri State College, 1940; Ph.D., physical chemistry, University of Illinois, 1945

Professional Experience: research chemist, E. I. du Pont de Nemours & Company, 1945–1946; chemist, Clinton Laboratory, 1947; associate chemist, Argonne National Laboratory, 1948–1949; aeronautical research scientist, Lewis Laboratory, National Advisory Committee on Aeronautics, 1949–1953, assistant chief, chemical branch, 1954–1955; Rockefeller fellow, Cambridge University, 1953–1954; group leader in combustion, Magnolia Petroleum Company, 1955–1956; principal scientist and technical assistant to president, research and advanced development, Avco Corporation, 1956–1962, director of corporate research, 1962–1964, vice president, defense and industrial products, 1964–1968, corporate vice president and director of research, 1968–1985; founder, Simon Associates consulting firm

Dorothy Simon is a chemist who spent most of her career as a distinguished researcher in the aerospace industry. Her research interests included combustion, aerothermochemistry, and research management and strategic planning. After receiving her doctorate from the University of Illinois in 1945, where she completed some of the earliest work on radioactive fallout, she went to work as a research chemist for a variety of corporations and government agencies, including E. I. du Pont de Nemours, Clinton Laboratory, Argonne National Laboratory, the National Advisory Committee on Aeronautics (the predecessor of the National Aeronautics and Space Administration [NASA]), and Magnolia Petroleum Company. In 1953, she received a prestigious Rockefeller Foundation fellowship to

conduct research at key laboratories in England, France, and The Netherlands; upon returning to the United States, she spent the remainder of her career in research and administrative positions at Avco Corporation; in 1968, she was named vice president of research, the company's first female corporate officer. At Avco, she emerged as an international expert in the field of combustion and high-temperature composite materials for aircraft and missile systems.

Her father was head of the chemistry department at Southwest Missouri State College (now Missouri State University), where she received her undergraduate degree in 1940 and where she later established the Dr. Robert W. Martin Research Fellowship for chemistry majors in her father's honor. The university recognizes her as the first student to graduate with a perfect 4.0 grade point average. She has received two honorary doctorates, from Worcester Polytechnic Institute (1971) and Lehigh University (1978). Over the course of her career, she has served on prestigious national and international committees, including the NASA Space Systems and Technology Advisory Committee and the President's Committee on the National Medal of Science (1978–1981). She has also served on the boards of major corporations and was a trustee for two universities. She received the Rockefeller Public Service Award (1953) and the Society of Women Engineers Achievement Award (1966), and was named by *Business Week* magazine as one of the top 100 women in corporate America (1976). She was elected a fellow of the American Institute of Aeronautics and Astronautics and the American Institute of Chemists, and was a member of the American Association for the Advancement of Science, the American Chemical Society, and the Combustion Institute.

Simpson, Joanne Malkus (Gerould)

1923-2010

Meteorologist

Education: B.S., University of Chicago, 1943, M.S., 1945, Ph.D., meteorology, 1949

Professional Experience: instructor, meteorology, New York University, 1943–1944; instructor, meteorology, University of Chicago, 1944–1945; instructor, physics and meteorology, Illinois Institute of Technology, 1946–1949, assistant professor, 1949–1951; research meteorologist, Woods Hole Oceanographic Institution, 1951–1960; professor, meteorology, University of California, Los Angeles, 1960–1965; head, experimental branch, Atmospheric Physics and Chemistry Laboratory, Environmental Science Service Administration, 1965–1971;

director, experimental meteorology laboratory, National Oceanic and Atmospheric Administration (NOAA), Department of Commerce, 1971–1974; professor, environmental science and member, Center of Advanced Studies, University of Virginia, 1974–1976, W. W. Corcoran Professor, 1976–1981; head, Severe Storms Branch, Goddard Space Flight Center, National Aeronautics and Space Administration (NASA), 1979–1988, chief scientist, meteorology and earth sciences, 1988–1992, science director, 1992–1998

Concurrent Positions: adjunct professor, University of Miami, 1971–1974; project scientist, tropical rainfall measuring mission, Goddard Space Flight Center, 1986–; member, board of directors, Atmospheric Sciences and Climatology of National Research Council (NRC) and National Academy of Sciences (NAS), 1990–; chief scientist, Simpson Weather Associates, 1974–1979

Joanne Simpson was the first woman in the world to receive a doctorate in meteorology, and she had a distinguished career as a meteorologist in academia, government, and private business. She started college just at the beginning of World War II, and seized the opportunity to enter the meteorology training program on the University of Chicago campus. Meteorology is the science that deals with the atmosphere and its phenomena, including weather and climate, and after nine months of training, she and the other women in the program trained weather forecasters for the military services. At the end of the war, the women were expected to return to their families or get married, and some faculty members were openly hostile to women students who planned to continue their educations. Simpson had difficulty finding a faculty supervisor but eventually worked with a professor studying clouds and tropical meteorology, the subject of her later book, *Cloud Structure and Distributions over the Tropical Pacific Ocean* (1965). Without a fellowship, she had to work part-time to support herself and obtained a position teaching physics and meteorology at the Illinois Institute of Technology while completing the coursework for her doctorate.

Between subsequent academic appointments, Simpson held high-level positions with government research institutions, such as director of an experimental meteorology laboratory at Coral Gables, Florida, for NOAA, and, later, head of the severe storms division of NASA. She devised and developed a new concept of cloud-seeding experiments aimed at modifying the dynamics of cumulus clouds. When she was a faculty member in the Environmental Sciences Department of the University of Virginia, she and her husband, Robert Simpson, formed a private meteorology consulting service, Simpson Weather Associates. She was for many years the lead project scientist for NASA's Tropical Rainfall Measuring Mission (TRMM).

Simpson was elected to membership in the National Academy of Engineering in 1988. She received an honorary doctorate from the State University of New York, Albany (1991). Among her numerous honors are the Meisinger Award of the American Meteorological Society (1962) and the highest award of the American Meteorological Society, the Rossby Research Medal (1983). Other awards include the Silver Medal (1967) and Gold Medal (1972) of the Department of Commerce, the V. J. Schaefer Award of the Weather Modification Association (1979), the Exceptional Science Achievement Medal of NASA (1982), and the International Meteorological Organization Prize (2002). She was a fellow of the American Meteorological Society (AMS) and served as the first female president of the AMS in 1989. She was a member of the American Geophysical Union and the Ocean Society, and a fellow of the American Academy of Arts and Sciences.

Further Resources

Weier, John. "Joanne Simpson (1923–2010)." Earth Observatory. NASA. (23 April 2004, updated 2010). <http://earthobservatory.nasa.gov/Features/Simpson/simpson.php>.

Center for Science and Technology Policy Research, Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder. 2002. "Women in the Atmospheric Sciences—Astounding Progress since World War II: Personal Viewpoint of Joanne Simpson in 2002." *WeatherZine*. 34. (June 2002). <http://sciencepolicy.colorado.edu/zine/archives/34/editorial.html>.

Singer, Maxine (Frank)

b. 1931

Biochemist, Geneticist

Education: B.A., Swarthmore College, 1952; Ph.D., biochemistry, Yale University, 1957

Professional Experience: postdoctoral fellow, Public Health Service, National Institutes of Health (NIH), 1956–1958, research biochemist, National Institute of Arthritis, Metabolism, and Digestive Diseases, 1958–1974; chief, Nucleic Acid Enzymology Section, Biochemistry Lab, National Cancer Institute, 1975–1980, chief, Biochemistry Lab, 1980–1987, scientist emeritus; president, Carnegie Institution of Washington, 1988–2002; chair, Board of Directors, Whitehead Institute for Biomedical Research, Massachusetts Institute of Technology (MIT), 2003–

Concurrent Positions: visiting scientist, Weizmann Institute of Science, Israel, 1971; instructor, University of California, Berkeley, 1980

Maxine Singer is renowned as a leading scientist in the field of human genetics. Her research laboratory helped to decipher the genetic code, and she is a strong advocate for responsible use of genetics research. During the controversy in the 1970s over the use of recombinant DNA (deoxyribonucleic acid) techniques to alter genetic characteristics, she advocated a cautious approach, and she helped develop guidelines to balance the desire for unfettered research on genetics with designing research programs that make medically valuable discoveries and still meet goals to protect the public from possible harm. She spent her early career conducting research at the NIH, where scientists were learning how to take DNA fragments from one organism in order to insert them into the living cells of another. This new research potentially could lead to the discovery of cures for serious diseases, aid in the development of new crops, and otherwise benefit humanity. In 1972, Singer's colleague, Paul Berg of Stanford University, was the first to create recombinant DNA molecules. Later, he voluntarily stopped conducting studies involving DNA manipulation in the genes of tumor-causing viruses because some scientists feared that a virus with unknown properties might escape from the laboratory and spread into the general population.

In an unprecedented action in 1973, a group of scientists composed a public letter to the president of the National Academy of Sciences and published it in *Science* magazine. They warned that organisms of an unpredictable nature could result from the new technique and suggested that the academy recommend guidelines. The NIH began formulating guidelines for recombinant DNA research, and Singer was instrumental in preparing these guidelines. She also wrote a series of editorials and articles on the topic in *Science* over a period of about five years. She was a strong supporter of the first genetically engineered foods, such as “the Flav'r Savr tomato,” which reached American supermarket shelves in the 1990s.

In 1988, she became president of the Carnegie Institution, a research organization that conducts high-level biological, earth science, and astronomical research. She retired from Carnegie in 2002 and now serves on the Board of Directors for the Whitehead Institute for Biomedical Research at MIT. She is still affiliated with and conducts regular research at the National Cancer Institute. Singer and Paul Berg published two books on genetics, both of which have received positive reviews: *Genes and Genomes: A Changing Perspective* (1990), a graduate-level textbook on molecular genetics, and *Dealing with Genes: The Language of Heredity* (1992). Although not a textbook, it is a summary of the mechanisms of heredity and the ways in which biologists study and alter the microscopic structure of organisms.

Singer was elected to the National Academy of Sciences in 1979. She has been awarded more than 15 honorary doctorates and has been an advisor or committee member for many academic, governmental, and private organizations. In 1992, she received the National Medal of Science. Her numerous other awards include

a Distinguished Service Medal from the U.S. Department of Health and Human Services (1983) and a Public Service Award from the NIH (1995). Her work in bringing science education to inner-city children through her “First Light” weekend science program and through the Carnegie Academy for Science Education earned her the 2007 Public Welfare Medal from the National Academy of Sciences. She is a fellow of the American Academy of Arts and Sciences, and a member of the American Society of Biological Chemists, American Philosophical Society, and American Association for the Advancement of Science. In 2008, she became co-chair (with astronomer **Vera Rubin** and physicist **Myriam Sarachik**) of a National Academy of Sciences project to pair women scientists in the United States with Iraqi women scientists for mentoring and career support.

Further Resources

National Academy of Sciences. 2008. “International Twinning Project for Iraqi Women Scientists, Engineers, and Health Professionals.” Committee on Human Rights. (March 2008). http://sites.nationalacademies.org/PGA/humanrights/PGA_044086.

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

Carnegie Institution. Faculty website. <http://www.carnegieinstitution.org/singer>.

Sinkford, Jeanne Frances (Craig)

b. 1933

Physiologist

Education: B.S., Howard University, 1953, D.D.S., 1958; M.S., Northwestern University, 1962, Ph.D., physiology, 1963

Professional Experience: research assistant, psychology, U.S. Department of Health, Education, and Welfare, 1953; instructor, College of Dentistry, Howard University, 1958–1960; clinical instructor, dentistry, Northwestern University, 1963–1964; associate professor and chair, prosthodontics, Howard University, 1964–1974, professor, 1968–1991, associate dean, College of Dentistry, 1967–1974, dean, 1975–1991, professor, physiology, Graduate School of Arts and Science, 1976–1991; director, Center for Equity and Diversity, American Dental Education Association, 1991–

Concurrent Positions: attending staff, Howard University Hospital; Children’s Hospital, National Medical Center; District of Columbia General Hospital; trustee advisor, American Fund for Dental Health, 1975–1984

Lucy Hobbs Taylor, First Woman Dentist

Lucy Beaman Hobbs Taylor (1833–1910) was the first female professional dentist in the United States. She began her career as a schoolteacher but dreamed of attending medical school. Denied admission to both medical school and the dental college because of her sex, she studied privately with a professor from the Ohio College of Dental Surgery and began practicing in Cincinnati without a diploma in 1861. She gained membership in professional organizations and attended conferences before returning to the Ohio College to complete her formal education, finally earning her doctorate in dentistry in 1865 and paving the way for more women to enter the field. She later married and moved to Kansas, where she and her husband operated a successful joint dental practice. By the year 2003, women made up 17% of practicing dentists and more than 40% of dental students.

Jeanne Sinkford is a physiologist known for her research on dental issues, including endogenous anti-inflammatory substances, chemical healing agents, gingival retraction agents, hereditary dental defects, oral endocrine defects, and neuromuscular problems. She has the distinction of being the first black woman in the United States to become head of a university department of dentistry. She was born in Washington, D.C., and has spent most of her career at Howard University. She studied chemistry and psychology as an undergraduate and received her D.D.S. from Howard in 1958. She taught prosthodontics at the Howard dental school for two years before moving to Chicago, where she received a master's degree and then doctorate in physiology from Northwestern University. She returned to Howard University in 1964, where she rose through the ranks to full professor and, in 1975, became the first female dean of a dental college in the United States.

For many years, she also continued her dental practice by serving on the staffs of various local hospitals. She left Howard University in 1991 and now serves as Director of the Center for Equity and Diversity (formerly the Office of Women and Minorities) at the American Dental Education Association (ADEA) in Washington, D.C. When Sinkford began her career in the 1960s, only about 2% of dentists were female; the field is still heavily male-dominated, with only about 17% of practicing dentists female, but the numbers of women in dental schools is steadily increasing. At the ADEA and in other areas of her professional life, Sinkford has been committed to increasing the numbers of women and minorities in dentistry and the health professions in general.

Sinkford is an elected member of the Institute of Medicine of the National Academy of Sciences. She has received a number of honorary degrees and awards,

including the College of Dentistry Alumni Award for Dental Education and Research (1969) and the Alumni Federation Outstanding Achievement Award (1971), both from Howard University; an Alumni Achievement Award from Northwestern University (1970); a Certificate of Merit from the American Prosthodontic Society (1971); the Candace Award of the National Coalition of 100 Black Women (1982); a Trailblazer Award from the National Dental Association (2007); and the Herbert W. Nickens Award of the Association of American Medical Colleges (AAMC) (2009). She is a member of the board of directors for the NIH and in 1974 was inducted into the International College of Dentists. She is a fellow of the American College of Dentists and a member of the American Dental Association, International Association for Dental Research, American Association for the Advancement of Science, and New York Academy of Sciences.

Sitterly, Charlotte Emma Moore

1898–1990

Astronomer, Astrophysicist

Education: A.B., mathematics, Swarthmore College, 1920; Ph.D., astronomy, University of California, Berkeley, 1931

Professional Experience: computer, Princeton Observatory, 1920–1925; computer, Mount Wilson Observatory, Los Angeles, 1925–1928; computer, Princeton University, 1928–1929, assistant spectroscopist, 1931–1936, research associate, 1936–1945; physicist, atomic physics division, National Bureau of Standards, 1945–1968; assistant, Office of Standard Reference Data, 1968–1970; assistant, Space Science Division, U.S. Naval Research Laboratory, 1971–1978

Charlotte Moore Sitterly was an astrophysicist recognized for her work on major projects concerning atomic spectra, atomic energy levels, and spectroscopic data for more than 50 years. After studying mathematics at Swarthmore College, she worked as a “computer” at Princeton University and at Mount Wilson Observatory in Los Angeles, analyzing solar images, before completing her doctorate in astronomy at the University of California, Berkeley. She returned to Princeton as a research associate for several years, during which time she met and married physicist Bancroft W. Sitterly. She joined the National Bureau of Standards in 1945 and spent more than 20 years there compiling standard wavelengths and atomic spectral tables, which are still useful reference tools. She also authored or co-authored eight books, including *The Infrared Solar Spectrum* (1947), *Atomic Energy Levels* (1949–1958), and *An Ultraviolet Multiples Table* (1950–1962).

She served on numerous scientific committees, including as a member of the National Research Council, member of the International Astronomical Union, and consultant to a variety of organizations.

Sitterly received the Annie J. Cannon Prize (1937), the Silver Medal (1951) and Gold Medal (1960) of the U.S. Department of Commerce, the first Federal Woman's Award of the U.S. government (1961), the William F. Meggers Award of the Optical Society of America (1972), and the Bruce Medal of the Astronomical Society of the Pacific (1990). She received honorary doctorates from her alma mater, Swarthmore College (1962), University of Kiel in Germany (1968), and University of Michigan (1971). The Asteroid 2110 Moore-Sitterly is named in her honor. She was elected a fellow of the American Physical Society and the Optical Society of America, and a foreign associate of the Royal Astronomical Society of London. She also was a member of the American Association for the Advancement of Science and the American Astronomical Society.

Slye, Maud Caroline

1879 1954

Pathologist

Education: A.B., Brown University, 1899; University of Chicago, 1906, 1908–1911

Professional Experience: professor, psychology and pedagogy, Rhode Island State Normal School, 1899–1905; staff member, Sprague Memorial Institute, 1911–1944, instructor, pathology, University of Chicago, 1919–1922, assistant professor, 1922–1926, associate professor and director, Cancer Laboratory, 1926–1944

Maud Slye was a pioneer in the study of the inheritance of cancer in mice and how it relates to human cancers. The popular press called her the “American Curie” for her contributions. Her theories on cancer later were proven to be incorrect. At first, she theorized that susceptibility to cancer was limited to the presence of a single recessive characteristic, but she later modified her ideas to agree that more than one gene was involved. A tireless worker, she raised and kept pedigrees on over 150,000 mice during her career. She held a prestigious directorship, although she did not have a doctorate. After receiving her undergraduate degree from Brown University in 1899, she was appointed a professor of psychology and pedagogy at the Rhode Island State Normal School for seven years. She accepted an appointment as member of the staff at the new Sprague Memorial Institute (later affiliated with the University of Chicago) in 1911, retiring in 1944. During this time, she held a joint appointment as a faculty member in pathology at the University of

Chicago, rising to the rank of associate professor and director of the Cancer Laboratory in 1926.

Slye received many honors for her contributions to cancer research, including a Gold Medal from the American Medical Association (1914), a Gold Medal from the American Radiological Society (1922), and the Ricketts Prize of the University of Chicago (1915). Brown University granted her an honorary degree in 1937. In addition to her scientific papers, she wrote two books of poetry: *Songs and Solaces* (1934) and *I in the Wind* (1936). She was a member of the American Medical Association and the New York Academy of Sciences.



Pathologist Maud Slye was an early cancer researcher. (National Library of Medicine)

Further Resources

McCoy, Joseph J. 1977. *The Cancer Lady: Maud Slye and Her Hereditary Studies*. Nashville, TN: Thomas Nelson Books.

Rader, Karen Ann. 2004. *Making Mice: Standardizing Animals for American Biomedical Research, 1900–1955*. Princeton, NJ: Princeton University Press.

Small, Meredith F.

Anthropologist, Primatologist

Education: A.B., anthropology, San Diego State University, 1973; M.A., physical anthropology, University of Colorado, Boulder, 1975; Ph.D., anthropology, University of California, Davis, 1980

Professional Experience: assistant professor, anthropology, Cornell University, 1988–1991, associate professor, 1991–1997, professor, 1997

Meredith Small is an anthropologist and primatologist who specializes in biological and cultural anthropology, evolutionary biology, and human and primate behavior.

She began her career observing both wild and captive macaques and focused on female sexual behavior and care of offspring. She has been a professor of anthropology at Cornell University since 1988 and published her first book, *Female Choices: Sexual Behavior of Female Primates*, in 1993. *Female Choices* was a groundbreaking and controversial look at the different sexual choices made by female primates, showing that females are active participants in sexual and mating relationships.

Since the 1990s, Small has also been a prominent figure in the media with her articles for popular science magazines and websites on issues related to childrearing, sexuality, DNA analysis, and other issues. Her books include *What's Love Got to Do with It? The Evolution of Human Mating* (1995), the immensely popular *Our Babies, Ourselves; How Biology and Culture Shape the Way We Parent* (1998), *Kids: How Biology and Culture Shape the Way We Raise Our Children* (2001), and *The Culture of Our Discontent; Beyond the Medical Model of Mental Illness* (2006). In each of these works, Small has examined the intersection between biology and culture, and looked for lessons from nonhuman primates to explain human behavior, especially with regard to mating and parenting. Small characterized her work in *Our Babies, Ourselves* as a contribution to the new field of ethnopeditrics, or the cross-cultural study of childhood and childrearing that combines the fields of anthropology, psychology, child development, and pediatrics. In the book, Small argued that there is no right or wrong way to raise children and that our ideas about feeding, sleeping with, bonding with, and disciplining children has as much to do with culture as it does with natural instinct, and may not even always be what is “best” for children. In 2005, Small’s efforts in bringing scientific research to the general public were honored with an Anthropology in Media Award from the American Anthropological Association.

Further Resources

Cornell University. Faculty website. <http://falcon.arts.cornell.edu/anthro/faculty/small.html>.

Smith, Elske (van Panhuys)

b. 1929

Astronomer, Environmental Scientist

Education: B.S., astronomy, Radcliffe College, 1950, M.A., astronomy, 1951, Ph.D., astronomy, 1956

Professional Experience: research fellow, Harvard Observatory Solar Project, Sacramento Peak Observatory, Sunspot, New Mexico, 1955–1962; visiting fellow,

Joint Institute for Laboratory Astrophysics, Boulder, Colorado, 1962–1963; associate professor, astronomy, University of Maryland, College Park, 1963–1975, assistant provost, Division of Mathematics and Physical Science and Engineering, 1973–1978, professor, astronomy, 1975–1980, assistant vice chancellor of academic affairs, 1978–1980; dean, College of Humanities and Science, and professor, physics, Virginia Commonwealth University, 1980–1992, interim director, Center for Environmental Studies, 1992–1995, emerita professor, physics

Concurrent Positions: research associate, Lowell Observatory, Flagstaff, Arizona, 1956–1957; consultant, Goddard Space Flight Center, National Aeronautics and Space Administration (NASA), 1963–1965; lecturer, Osher Lifetime Learning Institute

Elske van Panhuys Smith is a solar physicist whose research included active regions on the sun, especially flares and plages; solar chromosphere; interstellar polarization; and solar physics. She was on the faculty at the University of Maryland for more than 15 years and was dean and director of the Center for Environmental Studies at Virginia Commonwealth University, an academic program she helped establish and for which she taught courses on Earth's atmosphere and on energy. In addition to her numerous scientific papers, she co-authored two books: *Solar Flares* (1963) and *Introductory Astronomy and Astrophysics* (1973; 3rd ed., 1992). She retired in 1995 and moved to Massachusetts, where she has been active in the community, and has lectured and taught continuing-education courses on astronomy, cosmology, archaeology, and environmental issues at the Osher Lifelong Learning Institute at Berkshire Community College.

As a scientist, teacher, and administrator, Smith was concerned with factors preventing women from pursuing careers in the sciences. In 1977, she participated in a symposium at the American Association for the Advancement of Science national meeting, the papers for which were collected and published as *Covert Discrimination and Women in the Sciences* (1978, edited by **Judith A. Ramaley**). As an administrator at the University of Maryland, Smith gained insight into the factors that are involved in hiring and promoting faculty members. She interviewed a number of women scientists in both academia and government positions throughout the country, and uncovered deliberate as well as covert discrimination, including discrimination against married women.

Smith is a fellow of the American Association for the Advancement of Science and a member of the International Astronomical Union and American Astronomical Society (founding member and first treasurer of Solar Physics Division). The Elske Smith Distinguished Lecturer Award at Virginia Commonwealth University is named in her honor.

Solomon, Susan

b. 1956

Atmospheric Chemist

Education: B.S., Illinois Institute of Technology, 1977; M.S., University of California, Berkeley, 1979, Ph.D., chemistry, 1981

Professional Experience: research chemist, National Oceanic and Atmospheric Administration (NOAA), 1981–

Concurrent Positions: adjunct instructor, University of Colorado, Boulder, 1983–; member, committee on solar and space physics, National Aeronautics and Space Administration (NASA), 1983–1986, space and earth science advisory committee, 1985–1988; head project scientist, National Ozone Expedition to McMurdo Sound, Antarctica, 1986–1987

Susan Solomon led expeditions to McMurdo Sound, Antarctica, to examine the “hole” in the ozone layer. Her theory was that chlorofluorocarbons (CFCs) could lead to Antarctic ozone destruction when CFCs encounter large masses of stratospheric clouds. CFCs are human-made gases that were widely used in refrigerators, air conditioners, aerosol spray cans, and the manufacture of semiconductors. In 1985, British scientists reported an ozone hole in the Southern Hemisphere over the South Pole during the pole’s spring month of October. The hole was located between the altitudes of about 32,000 and 74,000 feet (the stratosphere), which normally shields the Earth from the sun’s ultraviolet radiation. Scientists suspected the damage had been caused by CFCs but were unable to explain the process, but Solomon hit on the solution while attending a lecture on polar stratospheric clouds. She theorized that CFC derivatives react on the cloud surfaces. She volunteered to lead the otherwise all-male expedition to McMurdo Sound in 1986, with a follow-up trip in 1987, and her research supported the theory. Her explanation for the cause of the ozone hole is now generally accepted by scientists, and this research led many countries to pass legislation curtailing or outlawing the production and use of CFCs. Solomon continues to study the atmospheric chemistry of ozone in Antarctica as well as in the Arctic in the Northern Hemisphere.

A project during her senior year of college turned Solomon’s attention toward atmospheric chemistry. The project involved measuring the reaction of ethylene and hydroxyl radical, a process that occurs in the atmosphere of Jupiter. The summer before entering graduate school, she worked on a study of ozone in the upper atmosphere at the National Center for Atmospheric Research (NCAR) in Boulder, Colorado. At NOAA, she first worked in the Aeronomy Laboratory developing computer models of ozone in the upper atmosphere (*aeronomy* is the



Susan Solomon is an atmospheric scientist for the National Oceanic and Atmospheric Administration who helped explain the hole in the ozone layer over Antarctica. (NASA)

study of chemical and physical phenomena in the upper atmosphere). Although she was concentrating on theoretical studies, the McMurdo Sound expeditions provided an opportunity to take up experimental work in measuring chlorine dioxide in the atmosphere. In addition to her scientific papers, she is co-author (with Guy Brasseur) of *Aeronomy of the Middle Atmosphere: Chemistry and Physics of the Stratosphere and Mesosphere* (1984, 2nd ed., 1986).

Solomon was elected to membership in the National Academy of Sciences in 1992. She has received several awards, including the J. B. MacElwane Award of the American Geophysical Union (1985) and the Gold Medal for exceptional service from the U.S. Department of Commerce (1989). She was named Scientist of the Year in 1992 by *R&D Magazine*. In 2000, President Clinton honored Solomon with a National Medal of Science, and in 2004, she received the prestigious Blue Planet prize for her contributions to finding “solutions to global environmental

problems.” In 2007, she took on an even more public role in the debate over global warming as co-leader of the United Nations and World Meteorological Organization’s massive new report on global climate change. She is a member of the Royal Meteorological Society, the American Geophysical Union, and the American Meteorological Society.

Further Resources

Morell, Virginia A. 2007. “Ahead in the Clouds.” *Smithsonian*. 82–85. (February 2007). http://www.smithsonianmag.com/science-nature/ahead_clouds.html.

Sommer, Anna Louise

1889–1973

Plant Nutritionist

Education: B.S., University of California, Berkeley, 1920, M.S., 1921, Ph.D., plant nutrition and chemistry, 1924

Professional Experience: teaching fellow, botany, University of California, Berkeley, 1922–1924, plant nutritionist, 1924, assistant, 1924–1926; research fellow, University of Minnesota, 1926–1929; associate professor, plant nutrition, and associate soil chemist, Alabama Polytechnic Institute (Auburn University), 1930–1948, professor and soil chemist, 1948–1949

Anna Sommer was one of the earliest women identified as a soil chemist, and was responsible for identifying the essential nature of three different trace or “micronutrient” elements: copper (Cu), zinc (Z), and boron (Bu). Her research on plant nutrition and soil fertility, during what has been termed the “trace nutrient gold rush” of the early twentieth century, contributed to scientists’ understanding that certain elements were not only beneficial, but necessary for plant growth. She was able to test the effect of these elements on plant growth and reproduction by isolating them with purified water and salt. She published her findings in journals such as *Science*, *Plant Physiology*, and the *Soil Science Society of America Proceedings*. Her work led to the development of better fertilizers and other improvements in agricultural efficiency.

Sommer received all of her degrees from the University of California, Berkeley, including her doctorate in 1924. She continued on at Berkeley as a plant nutritionist and an assistant until relocating to the University of Minnesota, where she spent three years as a research fellow. She then accepted a position as an associate professor and soil chemist in the department of agronomy and soils at Alabama Polytechnic Institute in Auburn, Alabama (now Auburn University), where she conducted her experiments on trace elements. She was the only tenured woman in that

department and was promoted to full professor in 1948, just one year before her retirement. Sommer was a member of the American Association for the Advancement of Science, the American Society of Plant Physiologists, and the Soil Science Society of America.

Further Resources

Weaver, David. 2002. "Mystery-Solving Woman: Pioneering Female Agronomist Solved Early Riddles of Soil Science." *ASK Magazine*. Alabama Agricultural Experiment Station. <http://www.aes.auburn.edu/comm/pubs/askmagazine/fall02/pioneeringwoman.html>.

McIntosh, Marla S. and Steve R. Simmons. 2008. "A Century of Women in Agronomy: Lessons from Diverse Life Stories." *Agronomy Journal*. 100: S-53 S-69. http://agron.sci journals.org/cgi/content/full/100/Supplement_3/S-53.

Spaeth, Mary Louise

b. 1938
Physicist

Education: B.S., physics and mathematics, Valparaiso University, 1960; M.S., nuclear physics, Wayne State University, 1962

Professional Experience: technical staff member, later senior scientist and project manager, Hughes Aircraft Company, 1962–1974; physicist, program leader, Atomic Vapor Laser Isotope Separation, Lawrence Livermore National Laboratory, 1975–1990, systems engineering and chief technologist, National Ignition Facility, 1990–

Mary Spaeth is renowned for her work in developing the first tunable dye laser, a laser whose color could be changed in midstream. The term *laser* is an acronym for "light amplification by stimulated emission of radiation," and is the name of a device that produces a nearly parallel, nearly monochromatic, and coherent beam of light by exciting atoms to a higher energy level and causing them to radiate their energy in phase. She stumbled upon the method for the tunable dye laser while working on a government project at Hughes Aircraft Company in the mid-1960s, and the patent was thus owned by the U.S. Army. While the laser was developed for military uses, it also had practical consumer applications, such as the modern supermarket checkout lasers.

Since 1975, Spaeth has been with Lawrence Livermore National Laboratory in Berkeley, California, and is also credited with using the dye laser in isotope separation. The laser is now the primary source for deriving the isotopes used in

nuclear reactors, and because different isotopes of the same element absorb light at different frequencies, a properly tuned dye laser can be used to separate and alter the isotopic composition of many elements. Originally, scientists at Livermore worked exclusively on refining plutonium for nuclear weaponry, but now most activity is centered on providing a low-cost means of enriching uranium fuel for light-water nuclear power reactors. One of the most promising applications of the tunable dye laser is as part of a guide star project that will allow ground-based stellar observatories to achieve a resolution comparable to that received through the Hubble Space Telescope, which was launched in 1990.

Spelke, Elizabeth

b. 1949

Psychologist

Education: B.A., social relations, Radcliffe College, 1971; student, Yale University, 1972–1973; Ph.D., psychology, Cornell University, 1978

Professional Experience: professor, psychology, University of Pennsylvania; professor, psychology, Cornell University; professor, Brain and Cognitive Sciences, Massachusetts Institute of Technology (MIT), 1996–2001; professor, psychology, Laboratory for Developmental Studies, Harvard University, 2001–

Elizabeth Spelke is a cognitive psychologist whose innovative research has focused on the perceptual and cognitive capacities of young infants. Her philosophical interest in the origins of knowledge led to her conclusion that even very young babies have innate understandings of location, physical objects, identity, and even numbers and quantities. Her controversial methods and findings challenge the previously held belief that humans are born with sensory capabilities but no specific knowledge or capabilities for understanding abstract concepts, such as “object permanence.” Spelke argues that her experiments have shown babies as young as two and a half months comprehending the physical boundaries of objects, and infants as young as six months distinguishing between different sets of numbers. She sees these capabilities as innate, as part of our evolutionary development, and as the foundation for acquisition of other types of knowledge, including language. Critics charge that she has overestimated infant mental capabilities, or that it is nearly impossible to distinguish between innate knowledge and learned experience, since babies are learning from the moment of birth. Regardless, her research has influenced the course of cognitive development research.

Her research on infants also relates to her interest in the question of gender and cognitive development. She has concluded that there are no innate differences

between male babies and female babies, and therefore no biological basis for different aptitudes in, for example, math and science. This subject was one of contentious debate after Harvard University president Lawrence Summers made remarks in 2005 suggesting that there are fewer women faculty members at prestigious universities such as Harvard because there are fewer women interested in or capable of higher-level math and science. Spelke, on the faculty at Harvard since 2001, was one of those scientists who criticized Summers's remarks, backing up the innate similarities between male and female with her own scientific research. She wrote a widely distributed review of the available research, "Sex Differences in Intrinsic Aptitude for Mathematics and Science: A Critical Review." She has collaborated and co-authored other papers with brain and cognitive researcher **Nancy Kanwisher** of MIT, and with her Harvard colleague in the Laboratory for Developmental Studies, **Susan Carey**.

Spelke was elected to the National Academy of Sciences in 1999. She has received honorary doctorates from Umeå University, Sweden (1993), Ecole Pratique des Hautes Etudes, Paris, France (1999), and University of Paris-Descartes (2007). Her numerous other awards and honors include the Boyd McCandless Young Scientist Research Award (1984), a prestigious Guggenheim fellowship (1989), a Cattell Fellowship (1992), the MERIT Award of the National Institutes of Health (1993), the William James Award of the American Psychological Society (2000), a Distinguished Scientific Contribution Award of the American Psychological Association (APA) (2000), the Ipsen Prize in Neuronal Plasticity (2001), and the Jean Nicod Prize (2008). She is a fellow of the Society of Experimental Psychologists, American Academy of Arts and Sciences, and American Association for the Advancement of Science.

Further Resources

Harvard University. Faculty website. <http://www.wjh.harvard.edu/~lds/index.html?spelke.html>.

Talbot, Margaret. 2006. "The Baby Lab: How Elizabeth Spelke Peers into the Infant Mind." New America Foundation. *The New Yorker*. (4 September 2006). http://www.newamerica.net/publications/articles/2006/the_baby_lab.

Spurlock, Jeanne

1921–1999

Psychiatrist

Education: student, Spelman College, 1940–1942, Roosevelt University, 1942–1943; M.D., Howard University, 1947

Professional Experience: intern, Provident Hospital, Chicago, 1947–1948; resident, general psychiatry, Cook County Hospital, Chicago, 1948–1950; fellow, child psychiatry, Institute for Juvenile Research, Chicago, 1950–1951, staff psychiatrist, 1951–1953; staff psychiatrist, Women’s and Children’s Hospital, Chicago, 1951–1953; Adult and Child Psychoanalytic Training, Chicago Institute for Psychoanalysis, 1953–1962; director, Children’s Psychosomatic Unit, Neuropsychiatric Institute, Chicago, 1953–1959; assistant professor, psychiatry, University of Illinois College of Medicine, 1953–1959; psychiatrist and chief, Child Psychiatry Clinic, Michael Reese Hospital, Chicago, 1960–1968; chair, Department of Psychiatry, Meharry Medical College, Nashville, 1968–1973; visiting scientist, National Institute for Mental Health, 1973–1974; Deputy Medical Director, American Psychiatric Association, 1974–1991

Concurrent Positions: clinical professor, George Washington University College of Medicine, and Howard University, College of Medicine; private practice in psychiatry, 1951–1968

Jeanne Spurlock was a noted psychiatrist who held many high-level appointments in hospitals and clinics as a specialist in child psychiatry. However, she changed the emphasis of her career in 1974, when she was appointed deputy medical director of the American Psychiatric Association. In that capacity, her work was primarily administrative, although she maintained a small private practice and was also a clinical professor at two local medical schools. She served as a lobbyist to policymakers to ensure funding for medical education and postgraduate education, particularly for minorities. She was involved in the recruitment and training efforts of minorities for research and was in charge of a fellowship program for minority psychiatric residents sponsored by the association.

Spurlock was co-editor of *Black Families in Crisis: The Middle Class* (1988), in which she wrote about stresses in parenting and male–female relationships. She was also co-editor of and wrote a chapter on single mothers for *Women’s Progress: Promises and Problems* (1990), which focused on various aspects of mothering, including the changing face of adoption in the United States, the problems of working mothers, the special problems of mothers of disabled children, and homosexuality and parenting. She was co-author (with Ian A. Canino) of *Culturally Diverse Children and Adolescents* (1994), which addresses the mental-health needs of African American, Latino, Asian American, and Native American children and adolescents. In this book, the authors explained how the assessment, diagnostic, and treatment phases of clinical work may need to be modified for cultural relevancy. She was also editor and contributor for a volume on *Black Psychiatrists and American Psychiatry*, published by the American Psychiatric Association in 1999.

Spurlock was a member of the American Academy of Child and Adolescent Psychiatry, which has named two fellowships in her honor: the Jeanne Spurlock Research Fellowship in Drug Abuse and Addiction for Minority Medical Students (in conjunction with the National Institute on Drug Abuse), and the Jeanne Spurlock Minority Medical Student Clinical Fellowship in Child and Adolescent Psychiatry. The American Medical Women's Association recognized her posthumously with their Elizabeth Blackwell Award in 2000.

Further Resources

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Stadtman, Thressa Campbell

b. 1920

Biochemist

Education: B.S., microbiology, Cornell University, 1940, M.S., microbiology and chemistry, 1942; Ph.D., microbial biochemistry, University of California, Berkeley, 1949

Professional Experience: bacteriologist, Sealright Co., New York, 1941; graduate fellow, bacteriology, Agricultural Experiment Station, Cornell University, 1941–1942, research assistant, 1942–1943; research associate, food technology, University of California, Berkeley, 1943–1946; research assistant, biochemistry, Harvard Medical School, 1949–1950; biochemist, Laboratory of Cellular Physiology and Metabolism, Enzyme Section, National Heart Institute (now National Heart, Lung, and Blood Institute), National Institutes of Health (NIH), Bethesda, Maryland, 1950–1974, chief, Section on Intermediary Metabolism and Bioenergetics, Laboratory of Biochemistry, 1974–1988, senior executive service, chief, 1988–

Concurrent Positions: fellow, Oxford University, England, 1954–1955; Rockefeller Foundation fellow, University of Munich, Germany, 1959–1960; institute of biological and physical chemistry, France, 1961

Thressa Stadtman has been recognized for her work in microbiology at the NIH since 1950. Her research has included amino acid intermediary metabolism, one-carbon metabolism, methane formation, microbial biochemistry, and selenium biochemistry, and her research on vitamin B₁₂ led to the discovery of new enzymes. A high school principal helped her get a New York State Regents

scholarship to attend Cornell, where she studied bacteriology, receiving her undergraduate and master's degrees in bacteriology. She remained at Cornell as a research assistant at the agricultural experiment station, then moved to the University of California, Berkeley to pursue her doctorate. It was at Berkeley that she met and married colleague Earl Stadtman, as both of them were working in the food-technology department researching food spoilage, a major problem for the military in shipping food rations overseas during World War II.

After receiving their Ph.D.s in biochemistry in 1949, the couple moved to Massachusetts, where Thressa was hired as a researcher at Harvard Medical School and Earl worked at Massachusetts General Hospital. Unable to find joint academic appointments, in 1950, the couple accepted positions as biochemists at the NIH's National Heart, Lung, and Blood Institute in Bethesda, Maryland. Unlike most universities at that time, the NIH did not have strict anti-nepotism rules and so, in the 1940s and 1950s as more women scientists earned doctorates, and as government research programs expanded in the postwar era, many scientist couples were hired and made names for themselves as researchers at the NIH. Earl Stadtman died in 2008, and Thressa remains affiliated with the NIH.

Thressa Stadtman was elected to the National Academy of Sciences in 1981 and has been an invited researcher and fellow at universities in England, Germany, and France. Among the other honors she has received are the Hillebrand Award (1979) and Rose Award (1987), both of the Chemical Society of Washington, the Klaus Schwarz Medal of the International Union of Biorganic Chemists (1988), the L'Oréal/Helena Rubenstein "Tribute to a Life Achievement" Award (France, 2000), the Gabriel Bertrand Prize Medal (Italy, 2001), and the Oxygen Club of Greater Washington's Lifetime Achievement Award (2007). She served as secretary (1978–1981) of the American Society of Biochemistry and president (1998–2001) of the International Society of Vitamins and Related Biofactors, and has been a member of the American Chemical Society, American Society of Microbiology, British Biochemistry Society, Northern Germany Academy of Sciences, and Executive Women in Government.

Further Resources

Park, Buhm Soon. "The Stadtman Way: A Tale of Two Biochemists at NIH." National Institutes of Health. <http://history.nih.gov/exhibits/stadtman/>.

Stanley, Louise

1883 1954

Chemist and Home Economist

Education: A.B., Peabody College, 1903; B.Ed., University of Chicago, 1906; A.M., Columbia University, 1907; Ph.D., biochemistry, Yale University, 1911

Professional Experience: instructor, home economics, University of Missouri, 1907–1911, professor and department chair, 1911–1923; chief, Bureau of Home Economics, U.S. Department of Agriculture (USDA), 1923–1950; consultant for home economics, Office of Foreign Agricultural Relations, 1950–1953

Louise Stanley was the first woman to direct a bureau in the USDA and was responsible for some of the earliest studies on food nutrition. After receiving her master's degree from Columbia University in 1907, she obtained an appointment as an instructor in the department of home economics at the University of Missouri. Her career coincided with the emergence of home economics as a profession and academic discipline, offering more employment opportunities for women scientists. She earned a doctorate from Yale University and advanced quickly through the ranks at Missouri, to full professor and chair of the home economics department, but left academia for government employment. In 1923, Stanley became the highest-ranking woman scientist in the federal government when she was appointed the first chief of the Bureau of Home Economics, USDA. She retired from the USDA in 1950, but spent three more years as a consultant for the Office of Foreign Agricultural Relations.

At the USDA, Stanley helped development four basic diet plans for families at different economic levels, and she authored a book, *Foods, Their Selection and Preparation* (1935). She directed the first national survey of rural housing and the first survey of consumer purchasing. Under her direction, the bureau also conducted time and motion studies of housekeeping methods and worked toward standardizing clothing sizes. She was the official representative of the USDA to the American Standards Association, and was the first woman to hold such an appointment. She later focused on nutritional needs and public education about nutrition in Latin America, and became involved with the UN Conference for Food and Agriculture.

Stanley received an honorary degree from the University of Missouri (1940), which later dedicated the home economics building in her name. She was a member of the American Chemical Society and the American Home Economics Association, which has named a scholarship fund for her.

Stearns, Genevieve

1892–1997

Biochemist

Education: B.S., Carleton College, 1912; M.S., University of Illinois, 1920; Ph.D., biochemistry, University of Michigan, 1928

Professional Experience: high school teacher, 1912–1918; assistant, chemistry, University of Illinois, 1918–1920; research associate, child welfare research station, University of Iowa, 1920–1925; assistant, biochemistry, University of Michigan, 1926–1927; research associate, pediatrics, University of Iowa College of Medicine, 1927–1930, assistant to associate professor, 1930–1943, research professor, pediatrics, 1943–1954, research professor, orthopedics, 1954–1958

Genevieve Stearns was recognized for her research on the nutritional needs of infants, children, and pregnant and nursing women. Her main areas of research included vitamin and mineral requirements, metabolism, and human growth. In addition to her scientific publications on nutritional requirements, she was a contributing author to the book *Infant Metabolism* (1956). Stearns's career followed the pattern of many women of her generation. After receiving her undergraduate degree from Carleton College in 1912, she was a high school teacher until 1918. She returned to school to receive her master's degree from the University of Illinois in 1920, working at the child welfare research station at the University of Iowa until 1925. She returned to school to receive her doctorate from the University of Michigan in 1928 while continuing to work in pediatrics at Iowa. She spent the remainder of her career at Iowa, where she rose through the ranks as a research professor in pediatrics and orthopedics at the University Hospitals, overseeing all pediatric blood and chemical work. In 1950, Stearns was selected by the UN World Health Organization to attend a series of seminars on metabolism in Europe. She traveled abroad again after her retirement, as the recipient of a prestigious Fulbright fellowship to work at the Women's College of Ein Shams University in Cairo, Egypt (1960–1961).

Stearns was elected a fellow of the American Institute of Nutrition. She was a co-recipient of an Alumni Achievement Award from Carleton College, the Borden Award of the American Home Economics Association (1942) and the Borden Award of the American Institute of Nutrition (1946). She was a member of the American Society of Biological Chemists, American Chemical Society, and American Institute of Nutrition.

Steitz, Joan (Argetsinger)

b. 1941

Biochemist, Molecular Biologist

Education: B.S., chemistry, Antioch College, 1963; Ph.D., biochemistry and molecular biology, Harvard University, 1967

Professional Experience: postdoctoral fellow, molecular biology, Cambridge University, 1967–1970; assistant professor, molecular biophysics and biochemistry, Yale University School of Medicine, 1970–1974, associate professor, 1974–1978, professor, 1978–1992, Henry Ford II Professor of Molecular Biophysics and Biochemistry, 1992–1998, Sterling Professor of Molecular Biophysics and Biochemistry, Yale University 1998–

Concurrent Positions: Josiah Macy Scholar, Max Planck Institut für Biophysikalische Chemie, Göttingen, Germany, and Medical Research Council Laboratory of Molecular Biology, Cambridge, England 1976–1977; Fairchild Distinguished Fellow, California Institute of Technology, 1984–1985; investigator, Howard Hughes Medical Institute, 1986–; scientific director, Jane C. Childs Fund for Medical Research, 1991–2002



Biochemist and molecular biologist Joan Steitz has contributed to research on autoimmune diseases such as lupus. (AP/Wide World Photos)

Joan Steitz is one of the most prominent scientists in the field of molecular genetics, and her research may help in the diagnosis and treatment of autoimmune diseases such as lupus. She discovered small nuclear ribonucleoproteins, or snRNPs, pronounced “snurps.” She is working in a field that was only discovered in her lifetime. While in graduate school at Harvard, her thesis advisor was James D. Watson, who with Francis Crick had demonstrated the double-helix structure of DNA in the 1950s, for which he won the Nobel Prize. She pursued postdoctoral studies at Cambridge University, where she worked with Crick on how bacterial ribosomes recognize where to start protein synthesis on messenger RNA (mRNA). The best known of the snRNPs are involved in the processing of mRNA in the cell nucleus of mammals. By a process called *splicing*, the double-stranded DNA is first transcribed into single-stranded RNA; then the sections are eventually rejoined in the same order in which they occurred on the DNA molecule. The team discovered that some patients with rheumatic diseases made antibodies against their own snRNPs, which resulted in the development of the splicing process. When physicians determine which antibodies patients have, they have additional clues to diagnosing certain diseases.

Lacking any female professors or researchers as role models, Steitz originally planned to attend medical school, but a summer job in the laboratory at the University of Minnesota piqued her interest in research and paved the way for her entrance into Harvard's graduate program in biochemistry and molecular biology instead. Among her honors, she considers the Weizmann Woman and Science Award (1994) from the New York Academy of Sciences among the most gratifying because it promotes women scientists, and she strongly believes that the presence of women scientists can be an inspiration to female students. Both she and her husband, Thomas Steitz, are Investigators at the Howard Hughes Medical Institute and hold appointments as Professors of Molecular Biophysics and Biochemistry at Yale University School of Medicine.

Steitz was elected to membership in the National Academy of Sciences in 1983, and in 1986, she was awarded the National Medal of Science. She has received six honorary degrees and numerous other awards, including the Eli Lilly award in biological chemistry (1976), U.S. Steel Foundation award in molecular biology (1982), the triennial Warren Prize of Massachusetts General Hospital (1989), the Discovery Award from the Christopher Columbus Fellowship Foundation for biomedical research (1992), the Weizmann Women in Science Award (1994), and the Gairdner Foundation Prize (2006). She is a fellow of the American Association for the Advancement of Science and a member of the American Society of Biological Chemists, American Academy of Arts and Sciences, American Philosophical Society, and New York Academy of Sciences. In 2005, she was elected to the Institute of Medicine of the National Academy of Sciences.

Further Resources

Wasserman, Elga. 2002. *The Door in the Dream: Conversations with Eminent Women in Science*. Washington, D.C.: Joseph Henry Press.

Howard Hughes Medical Institute. "Joan A. Steitz, Ph.D." http://www.hhmi.org/research/investigators/steitzja_bio.html.

Yale University. Faculty website. <http://www.mbb.yale.edu/faculty/pages/steitzj.html>.

Stern, Frances

1873–1947

Social Worker and Dietitian

Education: Garland Kindergarten Training School, Boston, 1897; student, Massachusetts Institute of Technology, 1909–1912; student, London School of Economics

Professional Experience: secretary and research assistant for Ellen Richards, Massachusetts Institute of Technology (MIT); industrial health inspector, Massachusetts State Board of Labor and Industries, 1912–1915; Division of Home Conservation, U.S. Food Administration; investigator, U.S. Department of Agriculture (USDA); American Red Cross, France, 1918–1922; founder, Boston Dispensary Food Clinic, 1918

Concurrent Positions: teacher, Simmons College School of Social Work, Tufts College Medical School, MIT, and State Teachers College, Framingham

Frances Stern was recognized as an early teacher of nutrition and dietetics. She had an interest in social reform and became interested in child nutrition due to her early work as a kindergarten teacher. She obtained a position as research assistant and special student of chemist Ellen Richards, founder of the American Home Economics Association, in New York. Stern attended home economics conferences with Richards, which stimulated her desire for further scientific knowledge about the relation of food to sociological problems. She enrolled in courses in food chemistry and sanitation at MIT. She developed a visiting housekeeping program for the Boston Association for the Relief and Control of Tuberculosis and later a similar program for the Boston Provident Association. In 1912, she obtained a position as an industrial health inspector for the State Board of Labor and Industries. During World War I, she worked as a member of the Division of Home Conservation of the U.S. Food Administration and, in the USDA, as an investigator of the adequacy of food for the industrial worker.

After consulting with the USDA and with the Red Cross in France during World War I, Stern studied economics and politics as a special student at the London School of Economics. She returned to Boston to establish the Boston Dispensary Food Clinic, which was based on her USDA research on the dietary needs and habits of the urban poor. At the clinic, she worked with immigrants on adapting their native foods to affordable products that were available in this country. She addressed the needs of her particular clients, including having her dietary charts and nutrition information printed in several different languages.

Stern's clinic established an international reputation, and in 1925, she received funding to establish a nutrition education program to train American and foreign doctors, dentists, social workers, and nurses in dietetics. She taught nutrition and social work at various schools, such as Simmons College, Tufts College Medical School, MIT, and the State Teachers College at Framingham. Stern was awarded an honorary degree from Tufts Medical School, and the Boston Food Clinic was eventually renamed the Frances Stern Nutrition Center at Tufts University.

Stern co-authored the book *Food for the Worker* (1917) to show the need for unifying science, social work, income, and nutrition. Her other co-authored books were

Food and Your Body (1932), *How to Teach Nutrition to Children* (1942), and *Diabetic Care in Pictures* (1946), and she was the sole author of *Applied Dietetics* (1936), which incorporated new information about the role of vitamins in nutrition. Stern was a member of the American Public Health Association, the American Home Economics Association, and the American Dietetic Association.

Further Resources

Tufts University. “Frances Stern Nutrition Center.” http://nutrition.tufts.edu/1177953850925/Nutrition-Page-nl2w_1177953851896.html.

Jewish Women’s Encyclopedia. “Frances Stern: 1873–1947.” <http://jwa.org/encyclopedia/article/stern-frances>.

Stickel, Lucille Farrier

1915–2007

Zoologist

Education: B.A., Eastern Michigan University, 1936; M.S., University of Michigan, 1938; Ph.D., zoology, 1949

Professional Experience: biologist, Patuxent Wildlife Research Center, U.S. Fish and Wildlife Service, 1943–1947, 1961–1972, director, 1972–1982

Lucille Stickel developed original methods for determining pesticide residue levels in wildlife. Her research included vertebrate population ecology and the ecology and pharmacotoxicology of environmental pollution. In her work in the pioneering field of pesticide research, she studied the significance and levels of chemical residues in animal brain tissue and developed a method still used to determine acceptable levels today. In 1946, she published one of the earliest reports on the pesticide DDT. Wildlife toxicology research has important implications for human health as well, since humans can consume either the polluted water or the contaminated fish and wildlife. She earned a master’s degree from the University of Michigan and joined the Patuxent Wildlife Research Center at Laurel, Maryland, as a biologist, in 1943. She returned to Michigan to complete her Ph.D., but then took several years off from her career before returning to Patuxent as a biologist in 1961. She was promoted to director in 1972, a position she held until her retirement in 1982. Her husband, William F. Stickel, was also a researcher at Patuxent, and the two collaborated on studies of the environmental effects of pesticides on birds and eggshell thinning, and on other research related to small mammal populations. In 1989, a chemistry and physiology lab at the Wildlife Research Center was renamed in their honor.

Stickel received the Federal Woman's Award of the Department of the Interior (1968), a Distinguished Service Award of the Department of the Interior (1973), the Aldo Leopold Award of the Wildlife Society (1974), and the Rachel Carson Award of the Society of Environmental Toxicology and Chemistry (1998). In 1974, she received an honorary doctorate from her alma mater, Eastern Michigan University.

Further Resources

Howell, Judd A. "Lucille Farrier Stickel 1915–2007." <http://www.pwrc.usgs.gov/what-snew/events/stickel/>.

Stiebeling, Hazel Katherine

1896–1989

Food Chemist and Nutritionist

Education: Skidmore College; B.S., Columbia University, 1919, M.A., nutrition, 1924, Ph.D., chemistry, 1928

Professional Experience: school supervisor, home economics, 1915–1918; supervising teacher, home economics, Kansas State Teachers College, 1919–1923; instructor, nutrition, Columbia University, 1924–1926; senior food economist, Bureau of Home Economics, U.S. Department of Agriculture (USDA), 1930–1944, assistant chief, 1943–1944, chief, 1944–1954, director of research, human nutrition and home economics, 1954–1957, director, institute of home economics, 1957–1960, deputy administrator, Agricultural Research Service, 1960–1963

Hazel Stiebeling was a nutritionist noted for her work in developing government dietary guidelines, including the concept of daily allowances of vitamins and minerals, or Recommended Dietary Allowances (RDA). During her long career at the USDA, her research involved the composition and nutritive values of food, energy metabolism, and food consumption habits of different population and income groups. Joining the USDA's Bureau of Home Economics shortly after it was established, she was promoted to assistant bureau chief in 1943 and chief in 1944. Although there were changes in the name of the bureau, she continued as head until 1960, when she was appointed deputy administrator of the Agricultural Research Service, retiring in 1963. Prior to joining the USDA, she had been a school supervisor in home economics, a supervising teacher for home economics at Kansas State, and an instructor in nutrition at Columbia University, where she had received all of her academic degrees, including a Ph.D. in chemistry in 1928. Stiebeling was part of a generation of women who brought scientific rigor to home economics and nutrition studies.

Stiebeling became interested in domestic science and food chemistry while in high school and then in her courses at Skidmore College. She taught school for three years before enrolling at Columbia University Teachers College. She went on for a master's degree and taught food and nutrition courses while completing her doctorate in chemistry. Her early research was on the effect and content of vitamins in the human body, and some of her studies were published in the *Journal of Biological Chemistry*. She was particularly concerned with the ability of low-income families to prepare nutritious food. While working at the USDA, she published the first research on quantitative dietary recommendations for vitamins and minerals, standards that were eventually applied nationally and internationally.

Stiebeling received the Borden Award in 1943, the Distinguished Service Award from the USDA in 1952, and the President's Gold Medal Award for civilian service in 1959. She was a member of the American Statistical Association and the American Home Economics Association, and a fellow of the American Institute of Nutrition. She received several honorary degrees.

Further Resources

Levine, Susan. 2008. *School Lunch Politics: The Surprising History of America's Favorite Welfare Program*. Princeton, NJ: Princeton University Press.

Harper, Alfred E. 2003. "Contributions of Women Scientists in the U.S. to the Development of Recommended Dietary Allowances." *The Journal of Nutrition*. 133: 3698–3702. (November 2003). <http://jn.nutrition.org/cgi/content/full/133/11/3698>.

Stokey, Nancy

b. 1950

Economist

Education: B.A., economics, University of Pennsylvania, 1972; Ph.D., economics, Harvard University, 1978

Professional Experience: assistant to associate professor, Department of Managerial Economics and Decision Sciences, Kellogg Graduate School of Management, Northwestern University, 1978–1983, professor, 1983–1987, Harold L. Stuart Professor of Managerial Economics, 1988–1990; professor, economics, University of Chicago, 1990–1996, Frederick Henry Prince Professor of Economics, 1997–2004, Distinguished Service Professor, 2004–

Concurrent Positions: visiting lecturer, economics, Harvard University, 1982; visiting professor, economics, University of Minnesota, 1983; visiting professor, economics, University of Chicago, 1983–1984; visiting scholar, Research Department, Federal Reserve Bank of Minneapolis, 2000–2002

Nancy Stokey is an economist who specializes in economic theory and economic development. She is particularly interested in the effect of education and job training on national economic growth. In addition to her numerous articles on global aid, social mobility, free trade, industrialization, development, and taxation, she has authored or co-authored textbooks, including *Recursive Methods in Economic Dynamics* (1989) and *The Economics of Inaction* (2008). After attending the University of Pennsylvania, she went on to receive her Ph.D. in economics from Harvard in 1978. She taught at Northwestern University for 12 years before moving to the University of Chicago in 1990, where she is a Distinguished Service Professor of Economics. In 2004, she was named one of eight economists (and the only woman) on



Economist Nancy Stokey. (Courtesy of the University of Chicago)

the Expert Panel of the Copenhagen Consensus Center, an international think tank that brings together researchers, policymakers, philanthropists, and nongovernmental organizations (NGOs) to address global challenges, such as global warming, terrorism, clean water, and development.

Stokey was elected a member of the National Academy of Sciences in 2004. She is also a fellow of the American Academy of Arts and Sciences and the Econometric Society, and served as vice president of the American Economic Association (1996–1997). She received an honorary doctorate from Northwestern University (2005), and her research has been supported by numerous grants from the National Science Foundation. She has been on the editorial board of the *Journal of Political Economy*, *Journal of Economic Growth*, *Games and Economic Behavior*, and *Journal of Economic Theory*.

Further Resources

Copenhagen Consensus Center. <http://www.copenhagenconsensus.com>.

University of Chicago. Faculty website. <http://home.uchicago.edu/~nstokey/>.

Stoll, Alice Mary

b. 1917

Biophysicist

Education: B.A., Hunter College, 1938; M.S., physiology and biophysics, Cornell University, 1948

Professional Experience: assistant, allergy, metabolism, and infrared spectrophotography, New York Hospital and Medical College, Cornell University, 1938–1943, temperature regulation, 1946–1948, physiological research associate, environmental thermal radiation, 1948–1953; physiologist, medical research laboratory, U.S. Naval Air Development Center (NADC), Pennsylvania, 1953–1956, special technical assistant, 1956–1960, head, thermal laboratory, 1960–1964, head, biophysical and bioastronautical division, 1964–1970, head, biophysical laboratory, crew systems department, 1970–1980

Concurrent Positions: U.S. Naval Reserves, 1943–1946; consultant, Arctic Aerospace Medicine Laboratory, Ladd Air Force Base, Alaska, 1952–1953

Alice Stoll was a pioneer in bioengineering with the U.S. Navy, and in particular was responsible for the development of fire-resistant and fire-retardant fibers and fabrics. Her research on the effects of heat and thermal radiation, and the biophysics of and engineering guidelines for thermal safety, led to the development of “Nomex” (manufactured by the Du Pont company), a fabric used in the uniforms worn by firefighters. She also studied the effects of rapid acceleration on the human heart. During the post–World War II era, the armed services were developing supersonic planes that made many physiological demands on crews as well as planes. Her work for the NADC involved assuring that crews can withstand the extremely cold temperature at high altitudes, the physiological stress of breaking the sound barrier at supersonic speeds, and the constant danger of fire in a closed environment. She personally developed and received patents on the specific instrumentation needed for her research.

Stoll received dual master’s degrees in physiology and biophysics from Cornell University in 1948 and subsequently worked as a physiological research associate in environmental thermal radiation at the medical school. She was simultaneously in the Naval Reserves and worked as a consultant for other government laboratories, including the Arctic Aerospace Medicine Laboratory in Alaska. She accepted an appointment at the NADC as a physiologist in the medical research laboratory in 1953. She then rose through the ranks as head of the thermal laboratory in 1960, and then head of the biophysical and bioastronautical division in 1964, and head of the biophysical laboratory in the crew systems department in 1970, formally retiring in 1980.

Stoll received the Federal Civil Service Award (1965), an Achievement Award of the Society of Women Engineers (1969), and the Paul Bert Award of the Aerospace Medical Association (1972). She was elected a fellow of the American Association for the Advancement of Science and of the Aerospace Medical Association, and was a charter member of the Biophysical Society. She was also a member of the American Physiological Society and the American Society of Mechanical Engineers.

Stroud-Lee, F. Agnes Naranjo

b. 1922

Radiation Biologist

Education: B.S., University of New Mexico, 1945; Ph.D., University of Chicago, 1966

Professional Experience: research technician, hematology, Los Alamos Scientific Laboratory, 1945–1946; associate cytologist, Argonne National Laboratory, 1946–1969; director, Department of Tissue Culture, Pasadena Foundation for Medical Research, 1969–1970; senior research cytogeneticist, Scientific Data Analysis Section, Jet Propulsion Laboratory, 1970–1975; staff cytogeneticist, health research division, Los Alamos Scientific Laboratory, 1975–1979; independent consultant, radiobiology and cytogenetics

Agnes Stroud-Lee has been recognized for her research in radiobiology and chromosomal abnormalities. Her work has increased scientific understanding of certain birth defects. Her research has included automation of chromosome analysis by computers, effects of radiation on animal tumors, effects of ionizing radiation *in vitro* and *in vivo*, and mammalian radiation biology. During her career, she worked at several of the major research centers in radiobiology, such as Los Alamos and Argonne National laboratories. Stroud-Lee is a member of the Tewa tribe of the Santa Clara Indian Pueblos and was the first Native American woman to hold a research scientist position at a national laboratory.

After receiving her undergraduate degree from the University of New Mexico in 1945, she was employed at Los Alamos for one year before receiving an appointment as associate cytologist at Argonne, where she worked until 1969. During this time, she was also working toward her Ph.D. in biology and zoology from the University of Chicago, which she received in 1966. In 1969, she moved to California as director of the tissue culture program at the Pasadena Foundation for Medical Research. She then accepted an appointment at the Jet Propulsion Laboratory as

a senior research cytogeneticist in 1970. She returned to Los Alamos in 1975 as a staff cytogeneticist in the health research division. In 1979, she left to consult in radiobiology and cytogenetics.

Stroud-Lee has received numerous honors and awards, including the Morrison Prize in Natural Sciences of the New York Academy of Sciences (1955), the National Aeronautics and Space Administration (NASA) Certificate of Recognition (1976), and a Diploma of Honor in Cytology at the First Pan-American Cancer Cytology Congress. She has been a member of the Radiation Research Society, the American Society for Cell Biology, the Biophysical Society, and the Tissue Culture Association. She is the subject of a children's book, *Scientist from the Santa Clara Pueblo, Agnes Naranjo Stroud-Lee*, published by the Equity Institute (1985). She was twice married and is listed variously in the sources as Stroud, Stroud-Schmink, or Stroud-Lee.

Stubbe, JoAnne

b. 1946

Chemist

Education: B.S., chemistry, University of Pennsylvania, 1968; Ph.D., chemistry, University of California, Berkeley, 1971

Professional Experience: postdoctoral fellow, chemistry, University of California, Los Angeles (UCLA), 1971–1972; assistant professor, chemistry, Williams College, 1972–1977; assistant professor, pharmacology, Yale University School of Medicine, 1977–1980; assistant professor to professor, University of Wisconsin, Madison, 1980–1987; professor, chemistry, Massachusetts Institute of Technology (MIT), 1987–1992, professor, chemistry and biology, 1992–

Concurrent Positions: National Institutes of Health (NIH) postdoctoral fellow, Brandeis University, 1975–1977

JoAnne Stubbe has made notable contributions to understanding how enzymes catalyze, or cause, chemical reactions. Her research has potential applications for antitumor, antiviral, and antiparasite activity, because inhibiting these enzymes interferes with the biosynthesis of DNA and cell growth. She held a prestigious postdoctoral appointment at UCLA, and was later an NIH fellow at Brandeis University. After having appointments at the Yale University School of Medicine and the University of Wisconsin, Madison, she moved to MIT as professor of chemistry and was appointed a distinguished professor of both chemistry and biology in 1992.



Chemist JoAnne Stubbe is presented with the National Medal of Science by President Barack Obama, 2009. (AP/Wide World Photos)

Stubbe was elected to membership in the National Academy of Sciences in 1992, and received the National Academy of Sciences Award in Chemical Sciences (2008) and a National Medal of Science (2009). She received a career development award from the NIH and the Pfizer Award in enzyme chemistry from the American Chemical Society (1986), given each year to a young scientist (under 40) for outstanding work in the field. She has also received the ICI-Stuart Pharmaceutical Award for excellence in chemistry (1989), a teaching award from MIT (1990), the Arthur C. Cope Scholar Award (1993), and the F. A. Cotton Medal

for Excellence in Chemical Research (1998). She is a member of the American Chemical Society, American Society of Biological Chemists, Protein Society, and American Academy of Arts and Sciences.

Further Resources

Massachusetts Institute of Technology. Faculty website. <http://web.mit.edu/chemistry/www/faculty/stubbe.html>.

Sudarkasa, Niara

b. 1938

Anthropologist

Education: student, Fisk University, 1953–1956; B.A., anthropology and English, Oberlin College, 1957; M.A., anthropology, Columbia University, 1959, Ph.D., anthropology, 1964

Professional Experience: assistant professor, anthropology, New York University, 1964–1967; assistant professor, anthropology, and research associate, Center for Research in Economic Development, University of Michigan, 1967–1970, associate professor, 1970–1976, professor, 1976–1986, director, Center for Afro-American and African Studies, 1981–1984, associate vice president, Academic Affairs, 1984–1986; president, Lincoln University, Pennsylvania, 1987–1998

Concurrent Positions: visiting scholar, Florida Atlantic University; Distinguished Scholar-in-Residence, African-American Research Library and Cultural Center, Ft. Lauderdale, Florida

Niara Sudarkasa is renowned as an authority in the fields of African women, especially Yoruba women traders, West African migration, and the African American and African family. She has also researched higher-education policies for black Americans and other minorities, and she is an advocate for minority access to education at the university level. Born Gloria Marshall, *Sudarkasa* was her first husband's name, and she adopted the African name *Niara* (an adaptation of a Swahili word for “a woman of high purpose”) as a result of her studies of the African continent in the 1970s. She studied Yoruba culture and language for her doctoral work, and in 2001, she was honored with the title of “Chief” in the Ife kingdom of the Yoruba of Nigeria, the first African American to hold the title. *Sudarkasa* has applied her study of West African culture to the African American family structure, with an emphasis on the role of black women within the family and society. Her published works include *Where Women Work: A Study of Yoruba Women in*

the Marketplace and in the Home (1973), *Exploring the African-American Experience* (1995), and *The Strength of Our Mothers: African and African-American Women and Families* (1996).

At the age of only 14, she won a Ford Foundation Early Entrant Scholarship to Fisk University. In her junior year, she went to Oberlin College as an exchange student and decided to stay there to receive her undergraduate degree. After completing her undergraduate degree at age 18, she went to Columbia University for graduate study, receiving another Ford Foundation Foreign fellowship to study in Nigeria and at the University of London School of Oriental and African Studies. She also spent two years at the University of Chicago as a fellow with a Carnegie Foundation project on a comparative study of new nations. She began her academic career at New York University and then spent 20 years at the University of Michigan. She directed the Center for Afro-American and African Studies and was a research scientist at the Center for Research in Economic Development. She became politically active while she was at Michigan, advocating on behalf of the students for a black studies program and for increasing the number of black and minority students in the university. She then spent a decade serving as the first female president of Lincoln University in Pennsylvania, one of the oldest black colleges in the United States. In 2000, she returned to her native Ft. Lauderdale as Distinguished Scholar-in-Residence at Florida Atlantic University, where she helped establish an African-American Research Library and Cultural Center.

Sudarkasa is a member of the American Ethnological Society, American Anthropological Association, African Studies Association, American Association for Higher Education, and Council on Foreign Relations. She has been awarded more than a dozen honorary degrees from institutions such as Fisk University, Oberlin College, Sojourner–Douglass College, Franklin and Marshall College, Susquehanna University, the University of Nigeria, and Fort Haiti University in South Africa.

Sullivan, Kathryn D.

b. 1951

Geologist, Astronaut

Education: B.S., earth sciences, University of California, Santa Cruz, 1973; Ph.D., geology, Dalhousie University, Nova Scotia, 1978

Professional Experience: staff member, National Aeronautics and Space Administration (NASA), 1978, astronaut, 1979–1993; chief scientist, National Oceanic and Atmospheric Administration (NOAA), 1992–1996; president and chief



Astronaut Kathryn Sullivan aboard the Space Shuttle Challenger, 1984. (NASA)

executive officer, Center for Science and Industry (COSI), Columbus, Ohio, 1996–2005; director, Battelle Center for Mathematics and Science Education Policy, Ohio State University, 2005–

Concurrent Positions: adjunct professor, Rice University, 1984–1992; captain, U.S. Naval Reserve; volunteer science advisor, COSI, 2005–

Kathryn D. Sullivan was one of the first women trained in the astronaut program in 1978, and she was the first American woman to perform a space walk. The first six women were selected for a training program in scientific, engineering, and medical duties, but none was to be trained in piloting the space shuttle. However, most of the women in the program took flying lessons anyway so they would be prepared to land the shuttle in an emergency. Sullivan passed her training tests and became an astronaut in 1979. Her shuttle assignments included software development, lead chase photography of launches and landings, and orbiter and cargo testing. She was a member of the spacesuit monitoring and extravehicular activity (EVA) crew, and served as capsule communicator in Mission Control for numerous shuttle missions. Her first space mission was as a mission specialist on STS 41-G in 1984; **Sally Ride** was also a member of the crew. Sullivan was the first woman to perform an EVA, with orbiter commander David Leetsma, and the two

demonstrated the feasibility of in-flight satellite refueling. On her second mission, STS-31 in 1990, she was a mission specialist when the crew deployed the Hubble Space Telescope (the telescope proved to have a defective mirror, and several years later, another shuttle crew installed a new mirror). On her third mission, STS-45 in 1992, she was a mission specialist and payload commander. Overall, she logged over 500 hours in space in her career as an astronaut.

Prior to completing a doctorate in geology, Sullivan had participated in several oceanographic expeditions under the auspices of the U.S. Geological Survey and the Woods Hole Oceanographic Institution. She resigned from the astronaut corps in 1992 and was selected by President George H. W. Bush to be chief scientist of NOAA, replacing oceanographer **Sylvia Earle** in that position. Always looking for new challenges in her career, Sullivan resigned from NOAA in 1995 to become director of COSI in Columbus, Ohio. In 2005, she became the director of the new Battelle Center for Mathematics and Science Education Policy at the John Glenn School of Public Affairs, Ohio State University. She remains affiliated with COSI as a science advisor.

Sullivan has served on various committees and government commissions related to marine science and ecosystems. She was appointed by President Ronald Reagan to the National Commission on Space in 1985 and participated in preparing guidelines for U.S. space exploration. In 2004, she was appointed to the National Science Board. She also served on the Pew Oceans Commission, which issued a 2003 report entitled “America’s Living Oceans: Charting a Course for Sea Change,” urging reform in ocean wildlife protection policy.

Sullivan has received a number of awards, including the NASA Exceptional Service Medal (1988 and 1991), National Air and Space Museum Trophy (1985), NASA Space Flight Medals (1984 and 1990), Haley Space Flight Award of the American Institute of Aeronautics and Astronautics (1991), Space Achievement Award of the American Aeronautic Society (1991), NASA Outstanding Leadership Medal (1992), Public Service Award of the National Science Board (2003), Astronaut Hall of Fame (2004), and *Aviation Week & Space Technology*’s Aerospace Legend Award (2005). She is a member of the American Institute of Aeronautics and Astronautics, Geological Society of America, American Geophysical Union, Society of Women Geographers, Explorers Club, Association of Space Explorers, and American Association for the Advancement of Science.

Further Resources

Kevles, Bettyann H. 2003. *Almost Heaven: The Story of Women in Space*. New York: Basic Books.

National Aeronautics and Space Administration. “Kathryn D. Sullivan (Ph.D.).” <http://www.jsc.nasa.gov/Bios/htmlbios/sullivan-kd.html>.

Sweeney, (Eleanor) Beatrice Marcy

1914–1989

Botanist

Education: A.B., Smith College, 1936; Ph.D., biology, Radcliffe College, 1942

Professional Experience: laboratory assistant, endocrinology, Mayo Clinic, 1942; fellow, University of Minnesota, 1942–1943; junior research biologist, Scripps Institution of Oceanography, California, 1947–1955, assistant research biologist, 1955–1960, associate research biologist, 1960–1961; research staff biologist, Yale University, 1961–1962, lecturer, biology, 1962–1967; lecturer, biology, University of California, Santa Barbara (UCSB), 1967–1969, associate professor, 1969–1971, professor, 1971–1981, associate provost, College of Creative Studies, 1978–1981

Beatrice Sweeney was recognized for her research on circadian rhythms (or biological clocks) in plants, and their effect on plant processes such as bioluminescence, photosynthesis, and cell division. In addition to hundreds of scientific papers, she also published a book, *Rhythmic Phenomena in Plants* (1969; 2nd ed., 1987). She completed her doctoral research in biology at Radcliffe and in 1947 moved to the Scripps Institution of Oceanography in California. She spent six years as a research biologist and lecturer at Yale University before returning to California as a professor at UCSB, where she spent the remainder of her career. Even after formally retiring in 1981, Sweeney remained active as a researcher, reviewer, and visiting lecturer. She was lecturing at the Woods Hole Oceanographic Institution in Massachusetts, when she suffered a stroke and passed away in the summer of 1989.

Sweeney began her scientific studies as an undergraduate botany student at Smith College. She was greatly influenced by her female teachers at Smith, but dismayed that, unlike male professors, most of the career women at that time (in the early 1930s) were not married and did not have families. She resolved to find her own way to balance family life with a scientific career and, throughout her years as a professor and administrator (including as an advisor for the UCSB Women's Studies Program), mentored female students on not giving up on their career plans. Sweeney was herself a powerful role model, as she was the mother of four children.

Sweeney's work was recognized by the Botanical Society of America, which awarded her the Darbaker Award in 1983. She was president of the Western Section of the American Society for Plant Physiology (1977–1978), the American Institute for Biological Sciences (1979–1980), the American Society for Photobiology (1979), the American Association for the Advancement of Science (1980), and the Phycological Society of America (1986), and was also a member

of the American Association for the Advancement of Science, the American Society of Plant Physiologists, the Society of General Physiologists, and the Society for the Study of Biological Rhythms. She was awarded honorary doctorates from Umea University in Sweden (1985) and from Knox College in Illinois (1986). UCSB established the Beatrice M. Sweeney Memorial Fund in her name.

Further Resources

University of California. "Eleanor Beatrice March Sweeney, Biological Sciences: Santa Barbara." <http://content.cdlib.org/xtf/view?docId=hb4p30063r&doc.view=frames&chunk.id=div00063&toc.depth=1&toc.id=>.

T

Talbot, Mignon

1869 1950

Geologist

Education: A.B., Ohio State University, 1892; Ph.D., Yale University, 1904

Professional Experience: high school teacher, physical geography, Columbus, Ohio, 1896–1902; instructor, geology, Mount Holyoke College, 1904–1905, associate professor and chair, 1905–1908, professor and chair, 1908–1935, professor and chair, geography, 1928–1935

Mignon Talbot was among the first women to enter the field of geology and paleontology, and she made an important discovery of a rare dinosaur skeleton, *Podokesaurus holyokensis*, found near Mount Holyoke College in Massachusetts. She spent her entire career at Mount Holyoke, where she headed the geology department and helped build a renowned program there in the early 1900s. Talbot grew up in Iowa, studied geology at Ohio State University, and then traveled abroad before returning to Ohio to teach physical geography to high school students. She did some graduate work and summer research at Ohio State, Harvard, and Cornell Universities before settling at Yale, where she received a Ph.D. in 1904. She joined the geology faculty at Mount Holyoke that same year and, three years later, became head of the department.

In addition to her teaching and research, she built a world-class fossil and mineral collection and science library at Mount Holyoke. In 1910, while on an expedition with her sister, Ellen (a Mount Holyoke philosophy professor), Talbot discovered the most complete dinosaur skeleton to date found in the Northeast; the rare find of a 45-foot-long, 150-million-year-old dinosaur was subsequently reported in the *American Journal of Science* (June 1911). A cast of the skeleton was made and kept at Yale University, but the original fossil was lost in a fire at Mount Holyoke's science hall in 1917. Besides the loss of the fossil, Talbot had to restock the collections of books as well as specimens, rocks, and minerals from scratch. She took her female students on numerous field trips to conduct this work over the next several years, building an even more extensive collection than before. In 1928, she traveled throughout Europe on a sabbatical, collecting

materials for use in her teaching. Upon her return, she was made chair and professor of the joint program in geology and geography.

In 1909, Mignon Talbot became the first woman elected to the Paleontological Society (1909); she was elected vice president of the Society in 1926. She was a fellow of the Geological Society of America and a member of the American Association for the Advancement of Science.

Further Resources

“Lost Dinosaur.” 1937. In Frances Lester Warner, *On A New England Campus*. Boston, MA: Houghton Mifflin.

Taussig, Helen Brooke

1898 1986

Cardiologist, Endocrinologist

Education: Radcliffe College, 1917–1919; A.B., University of California, 1921; M.D., Johns Hopkins University, 1927



In 1945, physician Helen Taussig developed a surgical technique for treating “blue baby” syndrome in newborn babies with heart defects. (Library of Congress)

Professional Experience: fellow, medicine, Johns Hopkins Hospital, 1927–1928, intern, pediatrics, 1928–1930; physician in charge, cardiac clinic, Harriet Lane Home, 1930–1963; associate professor, pediatrics, Johns Hopkins University, 1946–1959, professor, 1959–1963

Helen Taussig originated the idea for the “blue-baby” operation, first tried in 1945 as the Blalock-Taussig procedure, which involves treating babies with congenital malformations of the heart within the first few days after birth. After she received her M.D. from Johns Hopkins in 1927, and completed her internship, she spent her entire career as physician in charge of the cardiac clinic at the

Harriet Lane Home and as a member of the faculty of Johns Hopkins Medical School from 1946 until retiring in 1963. In 1962, she was the first physician to alert the United States to the dangers of thalidomide, a medicine routinely given to pregnant women to control nausea that was later found to cause deformities in the limbs of numerous newborns. She was also the first to demonstrate that changes in the heart and lungs could be diagnosed by X-ray and fluoroscope. Her colleague, Dr. Blalock, was elected to the National Academy of Sciences in 1946, the year after the two introduced the Blalock-Taussig procedure; however, Helen Taussig was not elected to the National Academy of Sciences until 1973.

In addition to many scientific papers, Taussig was the author of *Congenital Malformations of the Heart* (1947, rev. 1960). She was elected a master of the American College of Physicians and was the first woman president of the American Heart Association (1965). She also was a member of the American Pediatric Society and the Society for Pediatric Research. In recognition for her achievements, she received 20 honorary degrees plus numerous awards, including the Lasker Award (1954), the Gold Heart Award (1963), and the Medal of Freedom (1964).

Taussky-Todd, Olga

1906–1995

Mathematician

Education: Ph.D., mathematics, University of Vienna, 1930; Bryn Mawr College, 1934–1935; M.A., Cambridge University, 1937

Professional Experience: assistant, University of Göttingen, 1931–1932; assistant, University of Vienna, 1932–1934; lecturer, University of London, 1937–1943; scientific officer, Ministry of Aircraft Production, England, 1943–1946; researcher, Department of Scientific and Industrial Research, 1946–1947; mathematician, National Bureau of Standards, 1947–1957; research associate, California Institute of Technology (CalTech), 1957–1971, professor, 1971–1977

Concurrent Positions: member, Institute for Advanced Study, Princeton University, 1948; visiting faculty, Courant Institute for Mathematical Sciences, New York University, 1955; Fulbright visiting professor, University of Vienna, 1965

Olga Taussky-Todd was known for her work in algebraic number theory and matrix theory, which she helped popularize. Born in Austria-Hungary, she enrolled in the University of Vienna, where she first majored in chemistry but quickly dropped that study to concentrate on mathematics, graduating in 1930. She received an

appointment as an assistant at the University of Göttingen, where she edited several volumes on number theory. She received a fellowship to study at Bryn Mawr in Pennsylvania and then at Girton College in Cambridge, England. She taught briefly at the University of London, where she met fellow mathematician John “Jack” Todd, and the two were married in 1938. During World War II, she worked for a government agency in England and then moved to the United States again, where they both worked at the National Bureau of Standards. In 1957, the couple was recruited to CalTech, where he was a professor and she was a research associate; she was promoted to professor in 1971, the first female full professor at CalTech. During her tenure there, she mentored many graduate students in matrix theory before retiring in 1977. The couple collaborated for more than 50 years, and she authored or co-authored more than 300 papers. She was founding editor of the journal, *Linear Algebra and Its Applications*, and served as editor of *Linear and Multilinear Algebra*, *Journal of Number Theory*, and *Advances in Mathematics*.

Taussky-Todd was named a “Woman of the Year” in 1964 by the *Los Angeles Times*. She received the Ford Prize of the Mathematical Association of America (1970) and the Gold Cross of Honor for Science and Art from the Austrian government (1978). She was elected a fellow of the American Association for the Advancement of Science and was a member of the American Mathematical Society. She was also elected to the Austrian Academy of Sciences (1975) and the Bavarian Academy of Sciences (1985). She received an honorary Golden Doctorate from the University of Vienna (1980) and an honorary Doctor of Science degree from the University of Southern California (1988). In 1990, CalTech established the Olga Taussky–John Todd Lecture Program.

Further Resources

Luchins, Edith H. and Mary Ann McLoughlin. “In Memoriam: Olga Taussky-Todd.” *Notices of the American Mathematical Society*. 43(8): 838–847. (August 1996). <http://www.ams.org/notices/199608/taussky.pdf>.

Case, Bettye Anne and Anne M. Leggett. 2005. *Complexities: Women in Mathematics*. Princeton, NJ: Princeton University Press.

Taylor, Kathleen Christine

b. 1942

Chemical Engineer

Education: B.A., chemistry, Douglass College (Rutgers University), 1964; Ph.D., physical chemistry, Northwestern University, 1968

Professional Experience: fellow, University of Edinburgh, 1968–1970; associate senior research chemist, General Motors (GM) Corporation, 1970–1974, senior research chemist, 1974–1975, assistant head, Physical Chemistry Department, 1975–1983, head, Environmental Sciences Department, Research Laboratories, 1983–1985, head, Physics and Physical Chemistry Department, 1985–, chief scientist, GM of Canada, 2000–, director, Materials and Processes Laboratories, GM Research and Planning (retired)

Concurrent Positions: chair, Center for Automotive Materials and Manufacturing, Canada, 2002–2003

Kathleen Taylor is an expert on catalytic converters for automobiles, and her research includes surface chemistry, heterogeneous catalysis, and catalytic control of automobile exhaust emissions. The U.S. Congress passed the Clean Air Act in 1970, demanding that automobile manufacturers begin to significantly reduce auto exhaust emissions of carbon monoxide, hydrocarbons, and nitrogen oxides. That same year, Taylor began working for GM, where her early research led to the development of the catalytic converter, introduced in new vehicles by the mid-1970s. Her group was interested in understanding the catalytic conversion of nitrogen oxides in automobile exhaust, and she published a book on the topic, *Automobile Catalytic Converters* (1984). She spent more than 30 years at GM in a variety of research and administrative positions involving the development of catalysis, surface chemistry, surface coatings, corrosion, combustion, batteries, fuel cells, and chemical processes.

Taylor published dozens of scientific papers on her research, a significant number for a corporate scientist. Even after formally retiring, Taylor remains committed and active on issues related to energy efficiency, reduction of greenhouse gases, and new fuel technologies. She has served on numerous government and industry committees, including the Department of Energy (DOE) Hydrogen and Fuel Cell Technical Advisory Committee, DOE Council on Materials Science and Engineering, DOE Basic Energy Sciences Advisory Committee, Advisory Committee for Columbia University Center for Electron Transport in Molecular Nanostructures, and National Academies Board on Energy and Environmental Systems.

Taylor was elected to membership in the National Academy of Engineering in 1995. She is the recipient of the Garvan Medal of the American Chemical Society (1989) and was nominated by the National Women's History Project as one of their "Women Taking the Lead to Save Our Planet" (2009). She has been a member of the North American Catalysis Society, Materials Research Society (president, 1987), Society of Automotive Engineers (SAE), American Academy of Arts and Sciences, and Indian National Academy of Engineering (elected 2006), and a fellow of SAE International.

Further Resources

“Kathleen C. Taylor.” http://www.hydrogen.energy.gov/docs/bio_taylor.doc.

Tesoro, Giuliana (Cavaglieri)

1921–2002

Polymer Chemist

Education: Ph.D., organic chemistry, Yale University, 1943

Professional Experience: research chemist, Calco Chemical Company, 1943–1944; research chemist, Onyx Oil and Chemical Company, 1944–1946, head, organic synthesis department, 1946–1955, assistant director of research, 1955–1957, associate director, 1957–1958; assistant director of organic research, central research laboratory, J. P. Stevens & Company, Inc., 1958–1968; senior chemist, Textile Research Institute, 1968–1969; senior chemist, Burlington Industries, Inc., 1969–1971, director, chemical research, 1971–1972; research professor, Polytechnic Institute, 1982–1996

Concurrent Positions: visiting professor, Massachusetts Institute of Technology, 1972–1976, adjunct professor and senior research scientist, 1976–1982; member, committee on military personnel supplies, National Research Council, 1979–1982, committee on toxic combustion products, 1984–1989

Giuliana Tesoro was an internationally recognized expert on the science and technology of polymers. Her research involved synthesis of pharmaceuticals, textile chemicals, and chemical modification of fibers, and she made important contributions to developments in polymer flammability and flame retardants in her work with several textile companies. After receiving her doctorate in 1943, she worked summers for Calco Chemical Company before accepting a position as research chemist at Onyx Oil and Chemical Company in 1944. She was promoted to head of the organic synthesis department in 1946, assistant director of research in 1955, and associate director in 1957. She was appointed assistant director of organic research for J. P. Stevens & Company, then moved to the Textile Research Institute for two years. She accepted a position as senior chemist at Burlington Industries in 1969 and was appointed director of chemical research in 1971. She was appointed research professor at Polytechnic Institute in 1982.

Tesoro was a member of several committees of the National Academy of Sciences and the National Research Council concerning toxic materials and fire safety. She was president of the Fiber Society in 1974, and has been a member of the American Chemical Society, the American Association of Textile Chemists

and Colorists, the American Institute of Chemists, and the American Association for the Advancement of Science.

Tharp, Marie

1920–2006

Geologist

Education: B.A., Ohio University, 1943; M.A., geology, University of Michigan, 1945; B.S., mathematics, University of Tulsa, 1948

Professional Experience: junior geologist, U.S. Geological Survey, 1944; geologist, Stanolind Oil & Gas Company, Oklahoma, 1945–1948; assistant, Lamont-Doherty Geological Observatory, Columbia University, 1949–1952, research geologist, 1952–1960, research scientist, 1961–1963, research associate, 1963–1968; oceanographer, U.S. Naval Oceanographic Office, 1968–1983; owner and consultant, Marie Tharp Maps, 1983–2006

Marie Tharp was a geologist who pioneered charting the ocean floor at a time when little was known about undersea geology. The detailed maps she prepared indicated features that helped other scientists understand the structure and evolution of the bottom of the ocean. Of particular importance was her discovery of the valley that divides the Mid-Atlantic Ridge, which convinced other geologists that the ocean floor was being created at these ridges in various parts of the world and spreading outward. The confirmation of “seafloor spreading” led to the eventual acceptance of the theory of continental drift, or “plate tectonics.”

Although a few studies of the Mid-Atlantic Ridge had been done by the 1920s, scientists had not fully explored the seafloor until an earthquake near the Great Banks in the Atlantic Ocean in 1929 broke the transatlantic cables and there was a need to anticipate future earthquakes before laying new cables. Working with geologist Bruce C. Heezen at the Lamont-Doherty Geological Observatory in the 1950s, Tharp began preparing a “physiographic” diagram of the Atlantic Ocean floor. The resulting maps show how the floor would look if all the water were drained away, and her first map showed a deep valley dividing the crest of newly formed rocks making up the ridge. At the time, most scientists believed that the Earth was a shrinking globe, cooling and contracting from its initial hot birth, and that continental drift was impossible. For many years, Tharp herself was not able to participate in recording ocean-floor soundings because women were not permitted on U.S. Navy ships. Beginning in the late 1960s, she went on several research cruises and, in 1977, Heezen and Tharp published the *World Ocean Floor Panorama*, based on all available geological and geophysical data as well as more

than 5 million miles of ocean-floor soundings. They received the Hubbard Medal of the National Geographic Society in 1978, and their work was chronicled in the book by John Noble Wilford, *The Mapmakers*, first published in 1981.

Tharp retired from the observatory and from her later appointment with the U.S. Navy in 1983 and began doing independent oceanography consulting and writing articles about Heezen's life and work. She received the Lamont-Doherty Heritage Award in 2001, and her former institute has established a fellowship in her name to support women in the sciences. Until her death in 2006, she operated a map-distribution business, Marie Tharp Maps, which still sells prints of her ocean floor map.

Further Resources

Marie Tharp Maps. <http://www.marietharp.com>.

Columbia University, Lamont-Doherty Earth Observatory. "Marie Tharp, Pioneering Mapmaker of the Ocean Floor." http://www.ldeo.columbia.edu/news/2006/08_23_06.htm.

Wilford, John Noble. 2001. *The Mapmakers*. 2nd ed. New York: Random House.

Thomas, Martha Jane (Bergin)

1926–2006

Analytical Chemist, Physical Chemist

Education: B.A., chemistry, Radcliffe College, 1945; M.A., Boston University, 1950, Ph.D., chemistry, 1952; M.B.A., Northeastern University, 1981

Professional Experience: senior engineer, chemical laboratory, General Telephone and Electronics Corporation (GTE), 1945–1959, group leader, lamp material engineering laboratories, Lighting Products Division, 1959–1966, section head, chemical and phosphor laboratory, Sylvania Lighting Center, 1966–1972, manager, technical assistance laboratories, Lighting Products, 1972–1981, technical director, technical service laboratories, 1981–1983, director, technical quality control, 1983–1990

Concurrent Positions: instructor, chemistry, Boston University, 1952–1970; adjunct professor, chemistry, University of Rhode Island, 1974–1993

Martha Thomas is renowned for her work in phosphor chemistry at Sylvania Lighting/GTE. Her research includes phosphors, photoconductors, ion exchange membranes, complex ions, and instrumental analysis. Phosphors are the powdery substances used to coat the inside of fluorescent lighting tubes, and her inventions included developing the phosphors that made possible Sylvania's natural-daylight

fluorescent lamps and made mercury lamps 10% brighter. She holds more than 20 patents, including her first for a method of etching the fine tungsten coils that were designed to improve telephone switchboard lights. She went on to establish two pilot plants for the preparation of phosphors—pilot plants are experimental industrial setups in which processes or techniques planned for use in full-scale operations are tested in advance. She also developed a natural white phosphor that allowed fluorescent lamps to impart daylight hues and a phosphor that increased the brightness of mercury lamps.

Thomas studied chemistry at Radcliffe, intending to enter medical school, but instead accepted a job at Sylvania (later GTE), where she remained for 45 years. She attended graduate school at Boston University part-time while working and received her doctorate in 1952. She returned to school again in 1980 to obtain a master's degree in business administration so she could handle her new responsibilities at GTE as a manager. In 1983, she was the first woman to be made a director in her division, and she was one of the few women then working in phosphor chemistry. Although she had a heavy schedule as a researcher, manager, and mother of four, she also taught evening chemistry classes at Boston University and then served as an adjunct professor of chemistry at the University of Rhode Island.

In 1991, Thomas was named New England Inventor of the Year by Boston's Museum of Science, the Inventors Association of New England, and the Boston Patent Law Association. She also received the National Achievement Award of the Society of Women Engineers (1965) and the Gold Plate of the American Academy of Achievement (1966), and was the first woman to receive the New England Award of the Engineering Societies of New England. She was a fellow of the American Institute of Chemists and a member of the American Chemical Society, Electrochemical Society, and Society of Women Engineers.

Thompson, Laura Maud

1905–2000

Anthropologist

Education: B.A., Mills College, 1927; Ph.D., anthropology, University of California, Berkeley, 1933

Professional Experience: assistant ethnologist, Bishop Museum, Honolulu, 1929–1934; social scientist, U.S. Navy, Guam, 1938–1940; social scientist, Community Survey of Education, Territory of Hawaii, 1940–1941; coordinator, Indian education research project, U.S. Office of Indian Affairs, 1941–1947; research associate, Institute for Ethnic Affairs, 1946–1954; professor, anthropology, City

College of New York, 1954–1956; visiting professor, University of North Carolina, 1957–1958; visiting professor, North Carolina State College, 1958–1960; distinguished visiting professor, anthropology, Pennsylvania State University, 1961; professor, anthropology, University of Southern Illinois, 1961–1962; professor, anthropology, San Francisco State College, 1962–1963; consulting anthropologist

Laura Thompson was recognized for her research on Native Americans. Her research has included comparative interdisciplinary research in small communities, especially among Native Americans and Lower Saxons of West Germany; human ecology; and ecosystem approach toward population control.

She conducted field research in Fiji, Germany, Guam, Hawaii, Iceland, and the United States with the Papago, Navajo, Zuni, Sioux, and Hopi people. She also consulted for the Hutterite communities in Pennsylvania in tracing their early history in Germany before they immigrated to the United States. After receiving her doctorate from Berkeley in 1933, she held numerous faculty and visiting positions, including at City College of New York, the University of Southern Illinois, and San Francisco State College. She regularly consulted for educational and government agencies, including the U.S. National Indian Institute in Mexico, the U.S. Office of Indian Affairs, and the Hutterite Socialization Project at Pennsylvania State University.

Thompson was a prolific writer as well, publishing numerous scientific papers and books, including *Archaeology of the Mariana Islands* (1932), *Fijian Frontier* (1940), *Guam and Its People* (1940), *The Hopi Way* (1944; co-author), *Guam and Its People* (1947), *Culture in Crisis: A Study of the Hopi Indians* (1950), *Personality and Government* (1951), *Toward a Science of Mankind* (1961), and *The Secret of Culture* (1969). She held her last formal academic appointment in 1963, but continued to work as a consulting anthropologist, invited speaker, and author after that date. She received grants from the Viking Fund, a Wenner-Gren fellowship to study in New York and Iceland, and Rockefeller Foundation grants in 1951 and 1952. She was the founder of the Society for Applied Anthropology, and was elected a fellow of the American Anthropological Association, New York Academy of Sciences, American Association for the Advancement of Science, and Association for Social Anthropology in Oceania.

Thornton, Kathryn (Cordell)

b. 1952

Physicist, Astronaut

Education: B.S., physics, Auburn University, 1974; M.S., physics, University of Virginia, 1977, Ph.D., physics, 1979

Professional Experience: NATO fellow, Max Planck Institute for Nuclear Physics, Germany, 1979–1980; physicist, U.S. Army Foreign Science and Technical Center, Charlottesville, Virginia, 1980–1984; staff member, National Aeronautics and Space Administration (NASA), 1984, astronaut, 1985–1996; professor and associate dean, School of Engineering and Applied Science, University of Virginia, 1997–

Kathryn Thornton is a physicist who joined the NASA astronaut training program in 1984 and was involved in four shuttle missions: STS-33 (1989), STS-49 (1992), STS-61 (1993), and STS-73 (1995). She was a mission specialist aboard the space shuttle *Discovery* in November 1989. Her second mission was in 1992 aboard the space shuttle *Endeavour* on its maiden flight, and her third was again on the *Endeavour* in 1993, which was a Hubble Space Telescope servicing and repair mission. Her last flight was aboard the space shuttle *Columbia* in 1995, and the mission included conducting scientific experiments on the SpaceLab module. The Columbia flight was a unique experience for Thornton, who had a starring role in footage that was used on the television show *Home Improvement*, the first entertainment footage shot in space. In the scene, Thornton was taped using a screwdriver in the gravity-free environment. Her technical assignments have included flight software verification in the Shuttle Avionics Integration Laboratory, serving as a team member of the Vehicle Integration Test Team at Kennedy Space Center, and serving as a spacecraft communicator.

Like the other women astronauts who entered the NASA program since the late 1970s, she has a solid scientific background, with a doctorate in physics and a postdoctoral appointment at the Max Planck Institute for Nuclear Physics in Germany. Following that appointment, she was a physicist with the U.S. Army science and technology center before joining NASA. She retired from NASA in 1996 and remains committed to



Astronaut Kathryn Thornton preparing for the launch of the Space Shuttle Columbia, 1995. (NASA)

science education and to encouraging women in science and technology, including space flight. At the University of Virginia, she has been a faculty member and director of the Center for Science, Mathematics, and Engineering Education. She has also been a leading voice urging the U.S. Congress to support a manned mission to Mars.

Thornton received a NASA Distinguished Service Medal. She is a member of the American Association for the Advancement of Science and the American Physical Society.

Further Resources

Kevles, Bettyann H. 2003. *Almost Heaven: The Story of Women in Space*. New York: Basic Books.

National Aeronautics and Space Administration. "Kathryn C. Thornton (Ph.D.)." <http://www.jsc.nasa.gov/Bios/htmlbios/thornt-k.html>.

"University of Virginia's Kathryn Thornton Urges Congress to Back Manned Space Exploration to Mars . . . and Beyond." *UVA Today*. (3 April 2008). <http://www.virginia.edu/uvatoday/newsRelease.php?id=4748>.

Tilden, Josephine Elizabeth

1869 1957

Botanist

Education: B.S., University of Minnesota, 1895, M.S., 1897

Professional Experience: instructor, botany, University of Minnesota, 1898–1902, assistant professor, 1902–1910, professor, 1910–1937

Josephine Tilden was an expert on algae and phycology of the Pacific Ocean. She was ahead of her time in realizing the ecological and economic importance of algae as a marine life food source and spoke often on problems of ocean pollution, conservation, and industrial uses of algae. Her primary area of research was the Pacific Rim, and she conducted research on the shores of Japan, Australia, New Zealand, Hawaii, and the South Pacific islands, often accompanied by her elderly mother. She was also a specialist in local freshwater algae, and her book, *Minnesota Algae* (1910), remained a widely used technical reference for many decades. Her later work, *The Algae and Their Life Relations* (1935–1937), was the first effort by an American scientist to summarize the known characteristics of these important marine and freshwater plants.

Tilden spent her entire career in the Department of Botany at the University of Minnesota, where she was the first woman scientist on the faculty. In 1900, she

discovered an area of algae, seaweed, and tide pools along a desolate stretch of Canadian coastline, and subsequently used her own money, and donated land, to establish the Minnesota Seaside Station for research on Vancouver Island. Tilden was the subdirector and, along with her mother and the chair of the Minnesota botany department, hosted 25 to 30 professors, students, and lecturers every summer to conduct research on algae, lichen, animals, and the natural environment. The station operated between 1900 and 1906, when the University of Minnesota chose not to continue the program. Throughout her career, Tilden was at odds with the university over funding for her expeditions, as it was unusual for a Midwestern university to dedicate resources to ocean research. She retired in 1937 and took 300 boxes of her own algae specimens with her to Florida, which were later returned to the University of Minnesota after her death. Tilden had built an impressive collection of algae samples from around the world and drawn numerous students to the botany program; 10 years after her death, however, there was no longer a program in marine algae studies at Minnesota.

Born in Davenport, Iowa, Tilden received her undergraduate degree from the University of Minnesota in 1895 and her master's degree in 1897. She was appointed instructor in botany at the school in 1898 and promoted to assistant professor in 1902. Her promotion to full professor in 1910, even though she did not hold a doctorate, was an indication of the recognition she had received for her research and teaching. She was a delegate to the First Pan-Pacific Scientific Congress of 1920 and attended succeeding congresses in 1923 and 1926. She was a member of the American Society for the Advancement of Science, the American Society of Naturalists, the American Geographical Society, the Botanical Society of America, and the Torrey Botanical Club.

Further Resources

Brady, Tim. 2008. "Of Algae and Acrimony." University of Minnesota Alumni Association. (11 January 2008). <http://www.minnesotaalumni.org/s/1118/content.aspx?sid=1118&gid=1&pgid=1077&sparam=algae&scontid=0>.

Tilghman, Shirley M.

b. 1946

Molecular Biologist

Education: B.Sc., chemistry, Queen's University, Ontario, 1968; Ph.D., biochemistry, Temple University, Pennsylvania, 1975

Professional Experience: teacher, Sierra Leone, West Africa, 1968–1970; post-doctoral fellow, National Institutes of Health (NIH), 1975–1978; assistant

professor, Fels Research Institute, Temple University School of Medicine, 1978–1979; adjunct associate professor, human genetics and biochemistry and biophysics, University of Pennsylvania, 1980–1986; Howard A. Prior Professor of Life Sciences, Princeton University, 1986–2001, professor, molecular biology, 1986–, president, Princeton University, 2001–

Concurrent Positions: independent investigator, Institute for Cancer Research, Fox Chase Cancer Center, Philadelphia, 1979–1986; investigator, Howard Hughes Medical Institute, 1988–2001; founding director, Lewis-Sigler Institute for Integrative Genomics, Princeton University, 1998–2003

Shirley Tilghman is a molecular biologist and in 2001 became the first female president of Princeton University in New Jersey. Tilghman specialized in mammalian developmental genetics and was on the faculty at Princeton for 15 years before assuming the presidency. She was a founding member of the council on the Human Genome Project, a project for mapping all human DNA. Born and educated in Canada, she received her undergraduate degree in chemistry from



Molecular biologist Shirley Tilghman became the first female president of Princeton University in 2001. (AP/Wide World Photos)

Queen's University in Kingston, Ontario. She went on to earn a doctorate in biochemistry from Temple University in Philadelphia, Pennsylvania, and held a postdoctoral fellowship with the NIH, where she was involved in the first efforts to clone mammalian genes. She was then an investigator for the Institute for Cancer Research in Philadelphia and taught at the University of Pennsylvania before joining the life sciences faculty at Princeton in 1986. In 1998, she founded and became director of the interdisciplinary Institute of Integrative Genomics at Princeton. During this time, she simultaneously held an affiliation as an investigator at Howard Hughes Medical Institute. Tilghman has served on numerous committees and advisory councils for both academic and government organizations, and has been committed to science education and to

careers for women in the sciences. She served as chair of Princeton's Council on Science and Technology for seven years (1993–2000).

Tilghman was elected a foreign associate to the National Academy of Sciences (1996) and a member of the Institute of Medicine (1995), and served on the National Research Council's Commission on Life Sciences (1993–2001). She is a fellow of the American Philosophical Society, American Academy of Arts and Sciences, New York Academy of Sciences, and Royal Society of London, and a member of the American Society for Biochemistry and Molecular Biology, American Society for Cell Biology, and Society for Developmental Biology. In addition to 25 honorary degrees from universities in the United States, Canada, and England, she is the recipient of a Basic Science Award of the Society for the Advancement of Women's Health Research (1997), the Mellon Prize from the University of Pittsburgh (2000), the L'Oréal-UNESCO Women in Science Award (2002), a Lifetime Achievement Award from the Society of Developmental Biology (2003), the Radcliffe Institute Medal (2004), a Genetics Society of America Medal for outstanding contributions to the field (2007), and numerous other awards and honors.

Further Resources

Princeton University. "Office of the President." <http://www.princeton.edu/president/>.

Tinsley, Beatrice Muriel (Hill)

1941–1981

Astronomer

Education: B.Sc., University of Canterbury, New Zealand, 1961, M.Sc., physics, 1963; Ph.D., astronomy, University of Texas, Austin, 1967

Professional Experience: fellow, University of Texas, Austin, 1967–1968; visiting scientist, physics, University of Texas, Dallas, 1969–1973, assistant professor, astronomy, 1973–1974; associate professor, astronomy, Yale University, 1975–1978, professor, 1978–1981

Beatrice Tinsley was the first person to make a realistic, computer-generated model of how the color and brightness of a galaxy change as the stars that make up the galaxy are born, grow old, and die. Before her research, astronomers treated galaxies as static, unchanging objects. Since galaxies are the milestones that astronomers use to measure the universe as a whole, her evolutionary models of galaxies have had a profound impact on cosmology, the branch of astronomy that

deals with the general structure and evolution of the universe. In developing her models of galaxies while working on her doctoral dissertation, she added up the colors and luminosities of the evolving stars to find the total color and luminosity of the entire galaxy as it developed. Her models demonstrated how the results of work in many other areas of astronomy could be synthesized into models of the evolution of galaxies far more accurately than any previous models, and she was largely responsible for establishing the photometric evolution of galaxies as a field of study in astronomy.

Despite her short life, she had an extremely prolific and successful career, although she encountered many obstacles as a female scientist. A native of New Zealand, Tinsley studied physics at Canterbury University, and although she was interested in astronomy and cosmology as an undergraduate, there were no facilities available for her to write a master's thesis on the subject. She moved to the United States and received her doctorate at the University of Texas, only to find there were no job opportunities for her as an astronomer in Dallas, where she lived with her husband, fellow physicist Brian Tinsley, and their two adopted children. She obtained a position as a visiting scientist at the newly formed University of Texas, Dallas and received part-time National Science Foundation funding. She conducted research at Mt. Wilson, Lick, and Mt. Palomar observatories in California, and at the University of Maryland and Cambridge University. After she and her husband divorced, she took a tenure-track faculty position at Yale. In 1978, the same year she was promoted as the first female full professor of astronomy at Yale, she learned that a lesion on her leg was malignant skin cancer. The cancer later spread to her vital organs, and she died in 1981 at only 40 years old.

Among the several awards Tinsley received was the Annie Jump Cannon prize in 1974, named for the Harvard astronomer who specialized in stellar spectra. Tinsley herself is commemorated by a biennial prize awarded by the American Astronomical Society for exceptionally creative or innovative research and by a visiting professorship of astronomy at the University of Texas, Austin. She was a member of the American Astronomical Society, Royal Astronomical Society, and International Astronomical Union.

Tolbert, Margaret Ellen (Mayo)

b. 1943

Biochemist

Education: B.S., chemistry, Tuskegee University, 1967; M.S., analytical chemistry, Wayne State University, 1968; Ph.D., biochemistry, Brown University, 1974

Professional Experience: research technician, biochemistry, Tuskegee University, 1969, instructor, mathematics, 1969–1970; instructor, science and mathematics, Opportunities Industrialization Center, Providence, Rhode Island, 1971–1972; assistant professor, chemistry, Tuskegee University, 1973–1976; associate professor, pharmaceutical chemistry, and associate dean, School of Pharmacy, Florida A&M University, 1977–1979; professor, chemistry, and director, Research and Development, Carver Research Foundation, Tuskegee University, 1979–1988; budgets and control analyst, and senior planner, British Petroleum (BP) America Research Center, 1988–1990; director, Research Improvement in Minority Institutions (RIMI) Program, National Science Foundation, 1990–1993; director, educational programs, Argonne National Laboratory, University of Chicago, 1994–1996; director, New Brunswick Laboratory, U.S. Department of Energy, 1996–2002; senior advisor, Office of Integrative Activities, National Science Foundation, 2002–

Concurrent Positions: instructor, chemistry, summer Transitional Program, Brown University, 1973; visiting associate professor, medical sciences, Brown University, 1979; consulting scientist, Howard Hughes Medical Institute, 1994

Margaret Tolbert has moved successfully from a distinguished research career to academia to science administration in the corporate and government realms. She had already established herself as a noted researcher on the biochemistry of the liver when she changed her career plans in the late 1980s and became an administrator and dean for the Carver Research Foundation, and then took a number of positions in government and industry. In 1990, the National Science Foundation recruited her as program director for the RIMI Program. In 1994, she worked with the Howard Hughes Medical Institute to establish international research programs in Eastern Europe. Dr. Tolbert was the first African American and the first female to serve as Director of the U.S. Department of Energy's New Brunswick facility at Argonne National Laboratories, which brings together researchers in nuclear science.

Tolbert's high school teachers arranged for her to take advanced placement courses in mathematics and science, and she enrolled in Tuskegee University. Her initial goal was to study medicine, but she switched to chemistry for both financial and research reasons. She also had the opportunity for summer internships at Central State College in North Carolina and at Argonne National Laboratories in Illinois, where she was a member of a team that was studying the various chemical combinations made by uranium. In her later, high-level positions at Argonne, she remained committed to creating high school and post-high school programs and opportunities in science education such as she received.

After graduating from Tuskegee in 1967, she went on to Wayne State University in Detroit, Michigan, where she earned a master's degree in analytical chemistry in 1968. She returned as a researcher and mathematics instructor at Tuskegee

before being recruited to the doctoral program at Brown University in Rhode Island. While at Brown, she received financial aid from the Southern Fellowship Fund to research biochemical reactions in liver cells. She also taught basic science to nurses and mathematics to welders in night school in Providence, Rhode Island, where adults sought to upgrade their employment skills. In her later positions representing research institutes and government agencies, she has traveled widely for her research and educational mission to increase international communication among scientists and educators in different countries, and to increase the numbers of women and minorities in science, work she continues as a Senior Advisor for the National Science Foundation.

Among her numerous awards and honors, Tolbert has received a Certificate of Distinguished Service from the Federal Reserve System (1987), the Secretary of Energy Pride Award for Community Service (1998), a Chicago-Tuskegee Alumni Club President's Merit Award (1999), Performance Awards from the Chicago Operations Office of the U.S. Department of Energy (1997–2001), the Women of Color in Government and Defense Technology Award in Managerial Leadership (2001), and a Performance Award from the National Science Foundation (2005). In 2007, she received the Dr. George Washington Carver Distinguished Service Award of Tuskegee University. She is a fellow of the American Association for the Advancement of Science and a member of the American Chemical Society, New York Academy of Sciences, Institute of Nuclear Materials Management, and Society for Environmental Toxicology and Chemistry.

Further Resources

National Science Foundation. "Dr. Margaret E. M. Tolbert, Senior Advisor." <http://www.nsf.gov/od/oia/staff/tolbert.jsp>.

Townsend, Marjorie Rhodes

b. 1930

Aerospace Engineer, Electronics Engineer

Education: B.S., electrical engineering, George Washington University, 1951

Professional Experience: aide, physical science, National Bureau of Standards, 1948–1951; electronics engineer, basic and applied sonar research, Naval Research Laboratory, 1951–1959; section head, design and development of electronic instruments, Goddard Space Flight Center, National Aeronautics and Space Administration (NASA), 1959–1965, technical assistant to chief of systems

division, 1965–1966, project manager, small astronomical satellites, 1966–1975, project manager, applied explorer mission, 1975–1976, manager, preliminary systems design group of advanced systems design, 1976–1980; consultant, 1980–1990; director, Space Systems Engineering BDM International, 1990–1993; consultant, 1993–

Marjorie Townsend is renowned for her work in launching the first astronomical satellites in the Small Astronomy Satellite (SAS) program for NASA in the 1970s. She co-invented (and received a patent for) a digital telemetry system, and her research includes advanced space and ground systems design for a large variety of missions in space and terrestrial applications and in the space sciences, new applications for the use of the space shuttle, and improvements in the data system design of space stations. During her years with NASA, she was the only woman to work as a project manager for a satellite program, and as such, she was responsible for the origination, design, construction, and testing of the satellites, as well as for the actual launches of the instruments.

Townsend was the first woman to earn an engineering degree from George Washington University. She joined NASA's Goddard Space Flight Center in 1959, the year after the agency was established. She had been conducting sonar research at the Naval Research Laboratory by developing frequency multiplication systems, an analog logic computer, and new submarine detection and classification techniques; at NASA, her first assignment was to design a ground system for the forerunner of meteorological satellites. In 1966, she was placed in charge of the SAS program, a joint U.S.–Italian project, and she created quite a controversy when she persuaded NASA administrators to use a launch site owned and operated by the Italian government. Her research indicated that the launch site in the Indian Ocean off the coast of Kenya was the best site because it was located in an area where the satellite could be placed in an equatorial orbit, thereby missing the radiation belt and avoiding a significant amount of background noise. The data received from SAS revolutionized the study of x-ray-emitting stars.

Townsend left NASA in 1980 and has continued to work and consult on space systems and satellite programs. She has received numerous awards, including the Exceptional Service Medal (1971), Knight of the Italian Republic Order from Italy (1972), Federal Woman's Award from the U.S. Government (1973), George Washington University Distinguished Alumni Achievement Award (1976), and NASA Outstanding Leadership Medal (1980). She is a fellow of the American Institute of Aeronautics and Astronautics and of the Institute of Electrical and Electronics Engineers (IEEE), and a member of the American Association for the Advancement of Science, American Geophysical Union, and Society of Women Engineers.

Further Resources

“Marjorie Rhodes Townsend.” 2009. Interview for *Online Journal of Space Communication*. 15. (Spring 2009). <http://satjournal.tcom.ohiou.edu/issue15/townsend.html>.

Treisman, Anne

b. 1935

Psychologist

Education: B.A., psychology, Cambridge University, England, 1957; D.Phil., Oxford University, 1962

Professional Experience: research assistant, experimental psychology, University of Oxford, 1961–1963; staff member, M. R. C. Psycholinguistics Research Unit, 1963–1966; visiting research scientist, Behavioral Sciences Department, Bell Telephone Laboratories, New Jersey, 1966–1967; university lecturer, psychology, Oxford University, 1968–1978; professor, psychology, University of British Columbia, 1978–1986; professor, psychology, University of California, Berkeley, 1986–1994; professor, psychology, Princeton University, 1993–, James S. McDonnell Distinguished University Professor of Psychology, 1995–

Concurrent Positions: lecturer, Trinity College, Oxford University, 1961–1977, Somerville College, 1962–1966, St. Anne’s College, 1964–1967, fellow, St. Anne’s College, 1967–1978; fellow, Center for Advanced Study in Behavioral Sciences, Stanford University, 1977–1978; fellow, Canadian Institute for Advanced Research, 1984–1986; visiting scholar, Russell Sage Foundation, New York, 1991–1992

Anne Treisman is a research psychologist who has created models for testing visual perception and analyzing how the brain combines visual and auditory input in selective attention and memory. Her research combines, and has implications for, work in cognitive psychology, neuropsychology, and neuroscience. Treisman developed a Feature Integration Theory (FIT) to explain how human vision processes color, shape, size, light, motion, and other input by creating and combining separate “feature maps” that correspond to different areas of the brain. She studied patients with behavioral differences, such as attention problems, or with brain damage, to see how their brains combined the various visual stimuli (a process called the “binding problem”) to make sense of the whole. Her research revealed that there are neurological as well as behavioral or learned explanations for attention, memory, and perception.



Research psychologist Anne Treisman with her husband, Daniel Kahneman, in 2002. Treisman created models for testing visual perception, and analyzes other brain processes, such as attention and memory. (AP/Wide World Photos)

Treisman holds dual citizenship in the United States and Britain. She was elected to the National Academy of Sciences in 1994 as a foreign associate, but later became a regular member as a U.S. citizen. Among her awards are the Spearman Medal of the British Psychological Society for experimental research (1963), Howard Crosby Warren Medal of the Society of Experimental Psychologists (1990), Distinguished Scientific Contribution Award of the American Psychological Association (1990), and Golden Brain award of the Minerva Foundation (1996), and she was named a William James Fellow of the American Psychological Society (2002). She was elected to the Society of Experimental Psychologists, Royal Society of London, and American Academy of Arts and Sciences, and is a member of the Psychonomic Society, Association for Research in Vision and Ophthalmology, and Cognitive Neuroscience Society. She was awarded an honorary doctorate from the University of British Columbia (2004) and was named an Honorary Professor in the Institute of Psychology by the Chinese Academy of Sciences (2004). Her husband, Daniel Kahneman, is also a psychologist and won the Nobel Prize in Economics in 2002.

Further Resources

Princeton University. Faculty/laboratory website. <http://weblamp.princeton.edu/~psych/psychology/research/treisman/index.php>.

Turkle, Sherry

b. 1948

Psychologist, Sociologist

Education: B.A., social studies, Harvard University, 1970, M.A., 1973, Ph.D., sociology and psychology, 1976

Professional Experience: clinical intern, psychology, University Health Services, Harvard University, 1974–1975; assistant professor, sociology, Massachusetts Institute of Technology (MIT), 1976–1980, associate professor, 1980–1989, professor, 1991–

Concurrent Positions: licensed clinical psychologist, Commonwealth of Massachusetts, 1978–; founder and director, MIT Initiative on Technology and Self, 2001–

Sherry Turkle is a psychologist and sociologist who has done pioneering research on how humans interact with computers and computer programs, and how computers shape our very identities. Her work on robots and computers began before the age of the Internet, but the intrusion of computers into nearly every aspect of our lives has raised even more questions about the boundaries between computers and humans, and between real life and virtual reality. She has written on computer games, online and digital pets, and Internet chat rooms, and is considered by some to be an anthropologist or ethnographer of computer culture. A licensed clinical psychologist, she has been professor of sociology, technology, and science studies at MIT since 1976, and in 2001 founded an Initiative on Technology and Self research center. Her work has made her a high-profile media figure on the psychology of computer users, and she has been interviewed for popular magazines and television and radio shows.

Turkle entered Radcliffe College in 1965, but dropped out and moved to Paris after her mother died. She returned to Harvard to complete her degrees, earning a bachelor's and a master's, and, in 1976, her doctorate in sociology and psychology on the influence of Freud's psychoanalytic theory in France, the subject of her first book, *Psychoanalytic Politics* (1978). She became interested in computers and computer users when she accepted a position as an assistant professor of sociology

at MIT. She noticed students using computer language in their everyday conversations, even when talking about their emotions, speaking of “debugging their relationships” or excusing verbal slips as “information processing errors.” In her second book, *The Second Self: Computers and the Human Spirit* (1984; rev. ed., 2005), she theorized that the computer is not just a tool, but an evocative object with which one can have intense, almost intimate, relations.

For her third book, *Life on the Screen: Identity in the Age of the Internet* (1995), she interviewed more than 1,000 people, 300 of them children. The use of computers had increased dramatically, and she expressed her concern about the concept of computer literacy defined as teaching computer skills, but not necessarily critical thinking. She also warned about the abuses of online identities. She is not against the idea of having multiple identities, but warned of adults assuming false identities in order to prey on children. Other books were compiled from seminars and lectures from the Initiative on Technology and Self, including *Evocative Objects: Things We Think With* (2007), *Falling for Science: Objects in Mind* (2008), *The Inner History of Devices* (2008), and *Simulation and Its Discontents* (2009). New issues on which she has written articles and lectured include cell-phone use and the effect of an ever-present availability of friends through texting, chatting, and online access, especially among teenagers.

Turkle has been honored by numerous magazines and organizations as an innovator and voice of the computer age. She was named Woman of the Year by *Ms. Magazine* (1984), one of the Computer 200 innovators for the Association of Computing Machinery’s Fiftieth Anniversary celebration (1997), one of *Time* magazine’s Innovators of the Internet (2000), and one of the Top Ten Wired Women by ABC News (2002). She is a member of the American Psychological Association and the American Sociological Association, and a fellow of the American Association for the Advancement of Science, Boston Psychoanalytic Society and Institute, and World Economic Forum.

Further Resources

Massachusetts Institute of Technology. Faculty website. <http://www.mit.edu/~sturkle/>.

Tyson, Laura (D'Andrea)

b. 1947

Economist

Education: B.A., economics, Smith College, 1969; Ph.D., economics, Massachusetts Institute of Technology, 1974.

Professional Experience: staff economist, World Bank, 1974; assistant professor, economics, Princeton University, 1974–1977; assistant to associate professor, economics, University of California, Berkeley, 1977–1988, professor, 1988–2001, professor, Haas School of Business, University of California, Berkeley, 1990–2001, dean, 1998–2001; dean, London Business School, 2002–2006; professor, Haas School of Business, University of California, Berkeley, 2007–2008, S. K. and Angela Chan Professor of Global Management, 2008–

Concurrent Positions: Director of Research, Berkeley Roundtable on the International Economy, University of California, Berkeley, 1988–1992; director, Institute of International Studies, University of California, Berkeley, 1990–1992; chair, President's Council of Economic Advisors, 1993–1995; chair, National Economic Council, 1995–1996; principal, Law and Economics Consulting Group, 1997–2001

Laura Tyson is an economist renowned as an authority and advisor on global economic issues, global markets and trade, healthcare reform, government deficits, and the high-tech industry. She has served as economic advisor to two presi-



In the 1990s, economist Laura Tyson served as chair of President Bill Clinton's Council of Economic Advisors and chair of the National Economic Council. (Hulton Archive/Getty Images)

dents and has been the dean of two prestigious business schools. As the first female chair of the National Economic Council (NEC) under President Clinton in the 1990s, and as a member of President Obama's Economic Advisory Panel to address the national economic crisis in 2009, she has been one of the most influential economists in the nation. In 1992, she published a book that examined the American trade imbalance problem in depth, *Who's Bashing Whom: Trade Conflict in High Technology Industries*, in which she advocated aggressive action against foreign traders who close their markets to imports by blocking U.S. markets to the foreign traders. She is known for her ability to explain complex economic concepts in an understandable and interesting way, whether in the classroom, at a conference, or in the media.

As an undergraduate at Smith College in the 1960s, she planned to major in mathematics and psychology but changed her major to economics after taking an introductory course in that field. In her graduate program at the Massachusetts Institute of Technology, she became more interested in the practical applications of economic theory rather than the technical and statistical aspects of economics. After receiving her doctorate, she taught at Princeton before accepting a position at the University of California, Berkeley in 1977. She has been affiliated with the Haas School of Business at Berkeley since 1990, and served as dean of the school for three years before becoming the first female dean of the London School of Business, where she founded the Centre for Women in Business. She spent four years in London before returning to teach at Berkeley. In addition to her academic work and government advisory positions, she has consulted with numerous policy organizations, such as the Brookings Institution and the Center for American Progress, and sat on the boards of companies such as Morgan Stanley, AT&T, and Eastman Kodak, among others.

In addition to numerous reports and dozens of newspaper editorials, Tyson has published several other books dealing with international competition, trade, productivity, and politics. She is a member of the American Economic Association and the Association for Comparative Economic Studies, and a fellow of the American Academy of Arts and Sciences. She has been awarded honorary degrees from Smith College and from American University.

Further Resources

University of California, Berkeley. Faculty website. http://www2.haas.berkeley.edu/Faculty/tyson_laura.aspx.

U

Uhlenbeck, Karen (Keskulla)

b. 1942

Mathematician

Education: B.A., University of Michigan, 1964; M.A., mathematics, Brandeis University, 1966, Ph.D., mathematics, 1968

Professional Experience: instructor, mathematics, Massachusetts Institute of Technology (MIT), 1968–1969; lecturer, University of California, Berkeley, 1969–1971; assistant professor, mathematics, University of Illinois, Champaign-Urbana, 1971–1976; associate professor, University of Illinois, Chicago, 1977–1983; professor, mathematics, University of Chicago, 1983–1988; professor and chair, mathematics, University of Texas, Austin, 1988–

Concurrent Positions: visiting associate professor, Northwestern University, 1976; chancellor's visiting professor, University of California, Berkeley, 1979; Albert Einstein fellow, Institute for Advanced Study, Princeton University, 1979–1980; visiting member, Mathematical Sciences Research Institute, Berkeley, 1982; visiting professor, Harvard University, 1983; visiting professor, Max Planck Institute for Mathematics, Bonn, 1985; visiting professor, University of California, San Diego, 1986; visitor, Institut des Hautes Études Scientifiques, Bures-Sur-Yvette, France, 1987; visiting professor, mathematics, University of Texas, Austin, 1988; visitor, Mathematics Research Centre, Warwick University, England, 1992; member, Institute for Advanced Study, Princeton, 1995, distinguished visiting professor, 1997–1998

Karen Uhlenbeck is renowned for mathematical research on calculus of variations, global analysis, and gauge theories. Her work has had applications in theoretical physics and has contributed to current research on instantons, which are models for the behavior of surfaces in four dimensions. Mathematicians are looking at imaginary spaces that have been constructed by scientists who are examining other problems. For example, physicists who were studying quantum mechanics had predicted the existence of particle-like elements known as instantons. Uhlenbeck and other researchers built a model for understanding the behavior of instanton surfaces

in three and four dimensions. She is the co-author of the books *Instantons and 4-Manifold Topology* (1984) and *Geometry and Quantum Field Theory* (1995).

Uhlenbeck had planned to major in physics at the University of Michigan, but switched to mathematics. After graduating, she spent a year at New York University's Courant Institute; she then married and moved to Boston, where her husband was attending Harvard. She received a National Science Foundation graduate fellowship to work at Brandeis University; after receiving her Ph.D., she taught at MIT for a year, then moved to the University of California, Berkeley as a lecturer in mathematics. In 1971, Uhlenbeck and her husband both obtained positions at the University of Illinois. In 1988, she joined the faculty at the University of Texas, Austin, where she began a mentoring program for women in mathematics. Throughout her career, she has held a number of fellowships and visiting professorships at institutions in both the United States and abroad. In 1990, she traveled to Japan as only the second woman to present the keynote lecture at the International Congress of Mathematics.

Uhlenbeck was elected to membership in the National Academy of Sciences in 1986 and received a National Medal of Science in 2000. She has received several honorary doctorates and numerous fellowships and awards, including a five-year MacArthur Fellowship (1983), Alumna of the Year from the University of Michigan (1984), Alumni Achievement Award from Brandeis University (1988), Commonwealth Award for Science and Invention of PNC Bank Corporation (1995), and Steele Prize of the American Mathematical Society (2007). She was named one of America's 100 most important women in 1988 by *Ladies' Home Journal*. She is a member of the American Academy of Arts and Sciences, Mathematical Association of America, Association for Women in Mathematics, National Association of Mathematicians, and American Mathematical Society.

Further Resources

Henrion, Claudia. 1997. *Women in Mathematics: The Addition of Difference*. Bloomington: Indiana University Press.

University of Texas. Faculty website. <http://www.ma.utexas.edu/users/uhlen/>.



Van Rensselaer, Martha

1864 1932

Home Economist

Education: Chamberlain Institute, 1884; A.B., Cornell University, 1909

Professional Experience: public school teacher, 1884–1893; school commissioner, Cattaraugus County, New York, 1893–1899; head, extension program for farm wives, Cornell University, 1900–1903, instructor, home economics, 1903–1907, co-director, School of Home Economics, 1907–1925, professor, 1911–1932, co-director, New York State College of Home Economics, 1925–1932

Martha Van Rensselaer taught some of the first accredited home economics courses in the country at Cornell University in the early 1900s. Her early career followed the pattern of many educated women of her generation in that she first taught in various public and private schools. It was while serving as a country school commissioner in New York State that she became interested in the education of farm women and created a program, through Cornell, to provide reading and other classes to rural women. In its first few years, the program attracted thousands of women, and Van Rensselaer began offering other courses in home economics through the agricultural college. In 1907, a separate School of Home Economics was formed, with Van Rensselaer and **Flora Rose** as co-directors. After completing her own undergraduate degree program in 1909, Van Rensselaer became a professor in the home economics degree program. Along with Rose and another colleague, she co-authored *A Manual of Home-Making*, published in 1919. In 1925, their popular program was upgraded to a separate school, the New York State College of Home Economics.

In addition to her academic research, teaching, and administrative duties, Van Rensselaer served in a variety of government positions, including as a staff member of the U.S. Department of Agriculture (USDA) and special service for the American Relief Commission during World War I, and, later, as assistant director of the White House Conference on Child Health and Protection under President Hoover. She was also active in professional organizations, serving as president of the American Home Economics Association (1914–1916), home-making editor of the journal *Delineator* (1920–1926), and assistant director of



Home economist, Martha Van Rensselaer.
(Courtesy of Cornell University)

the White House Conference on Child Health and Protection (1930). She was chair of the home economics section of the Association of Land-Grant Colleges and Universities in 1928 and 1929. She was a member of the American Association of University Women committee to welcome physicist Marie Curie on her visit to New York City in 1921. In 2004, Van Rensselaer was posthumously inducted into the National 4-H Hall of Fame.

Further Resources

Cornell University. "Martha Van Rensselaer." <http://rmc.library.cornell.edu/homeEc/bios/marthavanrensselaer.html>.

Van Straten, Florence Wilhemina

1913–1992

Meteorologist

Education: B.S., New York University, 1933, M.S., 1937, Ph.D., chemistry, 1939

Professional Experience: assistant instructor, chemistry, New York University, 1933–1942; aerology engineer, U.S. Department of the Navy, 1946–1948, head, technical requirements section, Naval Weather Service, 1948–1962; consultant and writer

Concurrent Positions: U.S. Naval Reserve, 1942–1946

Florence Van Straten was a meteorologist whose research focused on metal-gas catalysis, the upper atmosphere, and atmospheric physics. She taught at New York University as an assistant instructor in chemistry while completing her doctorate in chemistry from that university in 1939. She continued teaching there until she joined the U.S. Navy's Women Accepted for Voluntary Emergency Services (WAVES) and launched her career in meteorology, the study of the physical processes that combine to produce weather. While she was in the WAVES during

World War II, she received a Certified Meteorologists diploma, which provided her entry into what had been solely a male profession. The science of meteorology really did not develop until World War II, when there was a need for accurate information to deploy troops and supplies all over the world. She was in the first group of 25 WAVES selected for training to overcome the shortage of available male meteorologists; 22 of these women completed the course. Her responsibility as a meteorologist, or aerology engineer, was to advise commanders of the Pacific Fleet on weather conditions for planning strategy. She also developed safety techniques using sonar and radar, and contributed other innovations to the field.

Van Straten continued working for the Naval Weather Service as a civilian until 1962, forecasting weather for the launching of long-range missiles. One study she initiated was to investigate the pattern of radioactive fallout in case of an atomic attack on the United States. She received the Navy's Meritorious Civilian Service Award in 1956 after 10 years of civilian service. After she left her civilian job with the Navy, she turned to consulting and writing. She was a member of the American Association for the Advancement of Science, the American Meteorological Society, and the American Geophysical Union.

Further Resources

Williams, Kathleen Broome. 2001. *Improbable Warriors: Women Scientists and the US Navy in World War II*. Annapolis, MD: Naval Institute Press.

Vaughan, Martha

b. 1926

Biochemist

Education: Ph.B., University of Chicago, 1944; M.D., Yale University, 1949

Professional Experience: intern, New Haven Hospital, Yale, 1950–1951; research fellow, University of Pennsylvania, 1951–1952; National Research Council fellow, cellular physiology, National Heart Institute, 1952–1954, member of research staff, 1954–1968, head, Metabolism Section, National Heart and Lung Institute, 1968–1974, acting chief, molecular disease, 1974–1976, chief, cell metabolism laboratory, 1974–1994, deputy chief, pulmonary critical care branch, 1994–; principal investigator

Concurrent Positions: senior assistant surgeon to medical director, U.S. Public Health Service, 1954–1989

Martha Vaughan is renowned for her research at the National Institutes of Health (NIH) on the mechanism of hormone action. She has worked for the same institute during her long career with the NIH, but the name has changed from National Heart Institute, to National Heart and Lung Institute, to National Heart, Lung, and Blood Institute. She and her husband, Jack Orloff, were among the several scientist couples hired by the NIH in the post–World War II era. Serving on the research staff, she was appointed head of the Metabolism Section in 1968, acting chief of the molecular disease branch in 1974, chief of the cell metabolism laboratory in 1974, and deputy chief of the pulmonary and critical care medical branch in 1994. She also was senior assistant surgeon to the medical director of the U.S. Public Health Service from 1954 to 1989. She is a co-editor of the book *ADP-Ribosylating Toxins and G Proteins: Insights into Signal Transduction* (1990), published by the American Society for Microbiology, and has written many scientific papers.

Vaughan was elected to membership in the National Academy of Sciences in 1985. She has received numerous awards, including the Harvey Society Lecturer award (1982); the G. Burroughs Mider Lecturer award, National Institutes of Health (1979); and the Meritorious Service Medal (1974), Distinguished Service Medal (1979), Command Officer Award (1982), and Superior Service Award (1993), all of the U.S. Public Health Service. She is a member of the American Society of Biochemistry and Molecular Biology, American Society of Clinical Investigation, Association of American Physicians, American Academy of Arts and Sciences, and American Society of Biological Chemists.

Vennesland, Birgit

1913–2001

Enzymologist, Plant Biologist

Education: B.S., biochemistry, University of Chicago, 1934, Ph.D., biochemistry, 1938

Professional Experience: assistant biochemist, University of Chicago, 1938–1939; research fellow, Harvard University medical school, 1939–1941; instructor, University of Chicago, 1941–1944, assistant to associate professor, 1944–1957, professor, 1957–1968; director, Max Planck Institute of Cell Biology, 1968–1970, director, Vennesland Research Institute, Max Planck Society, 1970–1981

Concurrent Positions: civilian consultant, Office of Scientific Research and Development, 1944; adjunct professor, biochemistry and biophysics, University of Hawaii, 1987–

Birgit Vennesland was a biochemist and plant biologist whose research focused on carboxylation reactions in animals and plants, mechanisms of hydrogen transfer in pyridine nucleotide dehydrogenases, and the enzymology and mechanism of plant photosynthesis. She was one of the first chemists to use radioactive carbon 11 to study carbohydrate metabolism. She served on several study teams for the National Science Foundation and the Public Health Service. After receiving her doctorate in biochemistry from the University of Chicago in 1938, she received a fellowship to study in Paris, but World War II interfered with those plans, and she went to Harvard University medical school instead. After working as a research fellow at Harvard for two years, she returned to Chicago as an instructor in 1941 and rose through the ranks to full professor by 1957. She left Chicago in 1968 for a position at another prestigious institute in Germany, being appointed a director at the Max Planck Institute of Cell Biology in 1968 and then, in 1970, director of another institute of the Max Planck Society that became known as the Vennesland Research Institute. She retired in 1981 and moved to Hawaii with her twin sister, a retired medical doctor. She remained affiliated as an adjunct professor at the University of Hawaii.

Vennesland received the Hales Award of the American Society of Plant Physiologists (1950) and the Garvan Medal of the American Chemical Society (1964), as well as an honorary degree from Mount Holyoke College (1960). She was elected a fellow of the New York Academy of Sciences and the American Association for the Advancement of Science, and was a member of the American Chemical Society, American Society of Biological Chemists, and American Society of Plant Physiologists.

Further Resources

Conn, Eric E. and Larry P. Solomonson. "Birgit Vennesland." *Women Pioneers in Plant Biology*. American Society of Plant Biologists. <http://www.aspb.org/committees/women/pioneers.cfm#Birgit%20Vennesland>.

Villa-Komaroff, Lydia

b. 1947

Molecular Biologist, Neurobiologist

Education: B.A., biology, Goucher College, 1970; Ph.D., cell biology, Massachusetts Institute of Technology, 1975

Professional Experience: research fellow, biology, Harvard University, 1975–1978; assistant professor, molecular genetics and microbiology, University of Massachusetts Medical Center, 1978–1982, associate professor, 1982–1985; senior research associate, Division of Neuroscience, Children’s Hospital, Boston, 1985–1996, acting head, 1988–1994, associate director, 1995; associate professor, neuropathology (genetics), Harvard Medical School, 1985–1988, associate professor, neurology (neuroscience and genetics), 1988–1996; associate vice president, Research, Northwestern University, 1996–1997, vice president, 1998–2002, and professor, neurology, Northwestern University, 1996–2002; vice president of research and chief operating officer, Whitehead Institute for Biomedical Research, Massachusetts Institute of Technology (MIT), 2003–2005; chief scientific officer, Cytonome, Inc., 2005–, chief executive officer, 2006–

Concurrent Positions: visiting postdoctoral fellow, Cold Spring Harbor Laboratories, 1976–1977; director, Laboratory of Molecular Genetics, Mental Retardation Research Center, Children’s Hospital, Boston, 1985–1996, associate director, 1987–1994, director, Transgenic Mouse Facility, 1990–1994

Lydia Villa-Komaroff is renowned for her theory of brain development. Her research includes growth factors in brain development, structure and function of insulin-like growth factors in brain development, and the structure and function of genes expressed in central and peripheral nervous systems. Her particular focus is the flow of information in the cell from DNA to RNA to protein. She has held a variety of research and teaching positions at Harvard University, the University of Massachusetts, Northwestern University, and MIT. In 2005, she became Chief Scientific Officer of Cytonome, Inc., a Boston-based biotechnology company that sells a device for cell sorting.

Both of Villa-Komaroff’s parents were the first in their respective families to attend college, and she became one of the first generation of Mexican Americans to receive a doctorate in this country. She became interested in a scientific career after taking part in a National Science Foundation summer program during high school. She began her undergraduate studies at the University of Washington in Seattle, but transferred to Goucher College in Baltimore, Maryland, to follow her husband’s job. She received her degree in biology and gained experience working for the National Institutes of Health (NIH) during the summers. She went on to graduate school at MIT, receiving her Ph.D. in cell biology in 1975. During her post-doctoral work at Harvard, she first worked on making proteins in bacteria. In 1976, a national controversy arose over recombinant DNA technology. Some people feared that taking the genes from one organism, such as a human, and putting them into bacteria, might somehow create a supergerm or a new disease. The Cambridge city

council temporarily banned certain experiments, and the Harvard research team had to move to a laboratory in Cold Spring Harbor on Long Island for a year. Villa-Komaroff's research team was the first to produce insulin from bacteria, a patented process that is now responsible for most insulin used by diabetics.

Villa-Komaroff has received several honorary degrees, and has been recognized with numerous awards and honors, including the Hispanic Engineer National Achievement Award (1992), the first Catalyst Award from the Science Club for Girls (2008), and MOSI's (Museum of Science and Industry) National Hispanic Scientist of the Year (2008). She was a member of the mammalian genetics study section of the NIH (1982–1984) and member of the Neurological Disease Program Project Review Committee (1989–1994). She is a member of the American Society for Microbiology, American Society of Hematology, American Society of Cell Biology, American Association for the Advancement of Science, International Society for Cellular Therapy, American Society for Blood and Marrow Transplantation, Society for Neuroscience, and Association for Women in Science, and is a founding member of the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS). She has served on the National Academy of Sciences Committee on Women in Science and the National Research Council Committee on Underrepresented Groups.

Further Resources

Whitehead Institute for Biomedical Research. "Lydia Villa-Komaroff among 100 Most Influential Hispanics in America." (16 October 2003). http://www.wi.mit.edu/news/archives/2003/wi_1016.html.

Vitetta, Ellen Shapiro

b. ca. 1942

Microbiologist, Immunologist

Education: B.A., Connecticut College, 1964; M.S., New York University, 1966, Ph.D., immunology, and M.D., 1968

Professional Experience: research assistant, biology, New York University, 1964–1968; postdoctoral fellow, New York University School of Medicine, 1968–1970, assistant research scientist, 1970–1971, assistant professor, microbiology, and associate research scientist, Department of Medicine, 1971–1974; associate professor, microbiology, University of Texas, Southwestern Medical Center, 1974–1976, professor, 1976–, director, Cancer Immunobiology Center, 1988–

Concurrent Positions: member, Medical Research Council, Cambridge, England, 1986

Ellen S. Vitetta is a renowned microbiologist whose most recent research has led to the development of a vaccine against ricin, a highly toxic compound made from castor beans that could be used as a biological weapon. After receiving her master's, doctorate, and M.D. degrees from New York University, she conducted research in the Medical School and Department of Medicine at that university for more than 10 years. She then moved to the University of Texas Southwestern Medical Center, where, in addition to being director of the Cancer Immunobiology Center, she holds the S. S. Patigan Distinguished Chair in Cancer Immunobiology. Her work in immunotoxicology also has implications for the treatment of cancer and of AIDS. In the late 1990s, she and her research team first discovered that a specific form of antibodies, chemically altered with ricin, could kill cancer cells. They applied their findings to target HIV cells as well and then to a vaccine against ricin known as RiVax. One of Vitetta's former students, **Linda Buck**, went on to win the Nobel Prize in Physiology or Medicine.

Vitetta has received a merit grant award from the National Institutes of Health (NIH) every year since 1987. She is a member of many distinguished committees and commissions, including the science board of the Ludwig Institute, the Task Force on Immunology of the National Institute of Allergy and Infectious Diseases, the science advisory board of the Howard Hughes Medical Institute, and the National Cancer Institute's Cancer Treatment Board, and is a consultant for pharmaceutical and biotech companies such as Eli Lilly, Abbott, and Genetics Institute. She has also served on the editorial boards of numerous journals in the field.

Vitetta was elected to membership in the National Academy of Sciences in 1994 and the Institute of Medicine in 2006. She is a recipient of the Taittinger Breast Cancer Research Award from the Komen Foundation (1983), NIH Merit Award (1987), Pierce Immunotoxin Award (1988), Women's Excellence in Science Award from the Federation of American Societies in Experimental Biology (FASEB) (1991), Abbott Award of the American Society of Microbiologists (1992), Rosenthal Award (1995) and Charlotte Friend Award (2002), both of the American Association of Cancer Research, and Mentoring Award (2002) and Lifetime Achievement Award (2007) of the American Association of Immunologists. In 1994, she served as president of the American Association of Immunologists, and in 2006, she was elected to the Texas Women's Hall of Fame.

Further Resources

University of Texas. Faculty website. <http://www8.utsouthwestern.edu/findfac/professional/0,2356,17609,00.html>.

W

Waelsch, Salome Gluecksohn

1907–2007

Geneticist

Education: Ph.D., zoology, University of Freiburg, 1932

Professional Experience: assistant, department of experimental cell research, University of Berlin, 1932–1933; research associate and lecturer, zoology, Columbia University, 1936–1953, lecturer, College of Physicians and Surgeons, 1953–1955; associate professor to professor, anatomy, Albert Einstein College of Medicine, 1955–1963, professor, molecular genetics, 1958–1978

Salome Waelsch was a mammalian geneticist whose research on the role of genes in normal and abnormal cell differentiation and on genetically controlled congenital abnormalities helped establish the field of developmental genetics. Her research focused on genetic mutations of mice spines and tails, and she later researched the hereditary nature of blood cells and chromosomal defects that affect liver function. After receiving her doctorate from the University of Freiburg in 1932, she worked briefly at the University of Berlin before fleeing to the United States in 1933. She and her husband (a Freiburg-trained biochemist who also obtained a position at Columbia in New York) were among the many Jewish scientists and academics forced to leave Nazi Germany. Salome did not have a job for three years but finally accepted an initially nonpaying research-associate position at Columbia University in 1936, where she also lectured in zoology. Waelsch joined the faculty of Albert Einstein College of Medicine in 1955, where she taught anatomy and molecular genetics for more than 20 years. She also served as chair of the genetics department between 1963 and 1976. Although she formally retired in 1978, she remained active in her research well into her eighties and nineties.

Waelsch was elected to membership in the National Academy of Sciences in 1979 and was awarded the National Medal of Science in 1993. She was awarded the Thomas Hunt Morgan Medal of the Genetics Society of America and the first Lifetime Achievement Award of the American Cancer Society. In 1982, Freiburg University awarded her an honorary degree, which she was hesitant to accept due to the circumstances that led her to have to leave Germany 50 years earlier. She was a fellow of the Royal Society and a member of the American Academy

of Arts and Sciences, New York Academy of Science, American Association of Anatomists, Genetics Society of America, Society for Developmental Biology, and American Society of Zoologists.

Further Resources

Solter, Davor. 2008. "In Memoriam: Salome Gluecksohn-Waelsch (1907–2007)." *Developmental Cell*. 14(1): 22–24. (January 2008). <http://www.sciencedirect.com/science?ob=ArticleURL&udi=B6WW3-4RKDVWC-7&user=10&rdoc=1&fmt=&orig=search&sort=d&docanchor=&view=c&acct=C000050221&version=1&urlVersion=0&userid=10&md5=a49e98dbcf1507db2038cc06a0ca4ac6>.

Walbot, Virginia Elizabeth

b. 1945

Biologist, Plant Geneticist

Education: B.A., biology, Stanford University, 1967; M.Phil., biology, Yale University, 1969, Ph.D., biology, 1972

Professional Experience: National Institutes of Health postdoctoral fellow, biochemistry, University of Georgia, 1972–1975; assistant to associate professor, biology, Washington University, St. Louis, 1975–1980; associate professor to professor, biological sciences, Stanford University, 1981–

Concurrent Positions: Guggenheim fellow and visiting scientist, C.S.I.R.O., Australia, 1987; adjunct associate professor, agronomy, University of Missouri, 1979–1990

Virginia Walbot is a plant geneticist whose research focus is corn genetics. Her research combines interests in plant molecular biology and development, genetics, and botany. She and other scientists have found corn to be the ideal organism for studying fundamental questions about genetics and development. The plant geneticist **Barbara McClintock** received the Nobel Prize in Physiology or Medicine in 1983 for her fundamental research on corn, and Walbot was able to confer with her while McClintock was still active in research in the late 1970s, and worked with her in her laboratory at Cold Spring Harbor. Transposable genetic elements, or mobile DNA, discovered by McClintock more than 50 years ago, figure prominently in Walbot's research.

Walbot is particularly interested in developmental timing, as plants have continuous development—that is, they are continuously making organs from scratch. For example, if one places a plant with dark leaves in sunlight, the dark leaves will fall off to be replaced by light-colored leaves to filter the sunlight. Scientists are using

recombinant DNA methods to manipulate plant genomes to breed for resistance to disease, while ensuring that there is a diversity of varieties that have any new trait. If only a few genetic variants are developed, it means that the food sources are more susceptible to a new disease or environmental conditions that are fatal to that one type. While she was on the faculty of Washington University, she developed, in cooperation with a team of University of Missouri researchers and commercial corn breeders, a corn that is genetically incapable of losing its sweetness and turning starchy. In addition to Walbot's numerous scientific publications, she is co-author of a textbook, *Developmental Biology* (1986), and co-editor of *The Maize Handbook* (1993), a compendium of the standard procedures and protocols for maize research.



Biologist and plant geneticist, Virginia Walbot. (Courtesy of the Stanford University News Service Library)

Walbot has consulted on numerous scientific, government, and industry advisory boards. She is the recipient of the Eppley Foundation Award (1993) and a National Geographic Society Explorer Award (1998). She is a member of the American Association for the Advancement of Science, Botanical Society of America, Society for Developmental Biology, and American Society of Plant Physiologists, and a Corresponding Member of the Mexican Academy of Sciences.

Further Resources

Stanford University. Faculty website. http://med.stanford.edu/profiles/Virginia_Walbot/.

Wallace, Phyllis Ann

1920–1993

Economist

Education: B.A., New York University, 1943; M.A., Yale University, 1944, Ph.D., economics, 1948

Professional Experience: economist and statistician, National Bureau of Economic Research, 1948–1952; associate professor, economics, Atlanta University, 1953–1957; senior economist, U.S. government, 1957–1965; chief of technical studies, U.S. Equal Employment Opportunity Commission, 1966–1969; vice president for research, Metropolitan Applied Research Center, New York City, 1969–1972; visiting professor, Sloan School of Management, Massachusetts Institute of Technology (MIT), 1972–1975, professor, 1975–1986

Concurrent Positions: lecturer, City College of New York, 1948–1951

Phyllis Wallace was a pioneer in research on the economics of racial and sexual discrimination in the workplace. She was the first black woman to receive a doctorate in economics from Yale University and the first black woman on the faculty to be tenured at MIT. She was also the first African American and first woman president of the Industrial Relations Research Association. Early in her career, she concentrated her research on issues dealing with international trade. She had written her dissertation on commodity trade relationships, concentrating on international sugar agreements. She first had a non-tenure-track position at New York University and, at the same time, did research for the National Bureau of Economic Research. She then moved to Atlanta University, where she was an associate professor, before working as a senior economist for an unnamed government agency that was later revealed to be the Central Intelligence Agency (CIA).

Wallace became chief of technical operations for the Equal Employment Opportunity Commission (EEOC) a few months after it started operations in 1965. She worked to coordinate hearings for the EEOC about racial employment patterns in many industries, and her research focused on the status of African Americans in urban poverty neighborhoods. At the Metropolitan Applied Research Center, she worked on issues affecting urban youth in labor markets and on issues affecting young black women, which had not been explored at that point. After joining the faculty of MIT, Wallace consulted on a federal lawsuit against communications company AT&T for discrimination against women and minority men. She wrote about this case in her 1976 book, *Equal Employment Opportunity and the AT&T Case*. Her other books included *Pathways to Work: Employment among Black Teenage Females* (1974) and *Women, Minorities and Employment Discrimination* (1977); in 1980, she published a study on *Black Women in the Labor Force*, in which she concluded that young black women have the highest unemployment rate and the lowest economic status of any group.

Even after her retirement in 1986, Wallace continued to work on issues related to discrimination and consulted with the Sloan School at MIT on sexual harassment issues and policies. The Sloan School established two funds for black

students and scholars in her name. Wallace received numerous honorary degrees, and was a member of the American Economic Association and the Industrial Relations Research Association.

Further Resources

Massachusetts Institute of Technology. "Professor Phyllis A. Wallace Dies." <http://web.mit.edu/newsoffice/1993/wallace-0113.html>.

Warga, Mary Elizabeth

1904–1991

Physicist

Education: B.S., University of Pittsburgh, 1926, M.S., 1928, Ph.D., spectroscopy, 1937

Professional Experience: industrial assistant, Mellon Institute for Industrial Research, 1928–1930, industrial fellow, 1930–1933; industrial fellow, University of Pittsburgh, 1934–1936, instructor to professor of physics and director of spectroscopy laboratory, 1936–1962, adjunct professor, physics, 1962–1972, emeritus

Concurrent Positions: executive secretary, Optical Society of America (OSA), 1959–1972

Mary Warga was a physicist whose research involved ultraviolet, visible, and infrared optical emission spectroscopy; optical absorption; and upper atmosphere spectroscopy. She worked at the Allegheny Observatory between 1926 and 1928. After receiving her master's degree from the University of Pittsburgh in 1928, she received several fellowships before being appointed instructor of physics in 1936. She rose through the ranks to professor of physics and director of the spectroscopy laboratory after receiving her doctorate in spectroscopy in 1937. After a distinguished career in teaching and research, Warga served as the first executive secretary of the OSA, having previously served four years on the Board of Directors. During her first few years in this position, which was headquartered in Washington, D.C., she still directed the spectroscopy laboratory at the University of Pittsburgh, but in 1962, she reduced her teaching load to become adjunct professor of physics. The laser had been invented in 1960, and the field of optics was an exciting new area of research. In her role as executive secretary of the OSA during this time, Warga brought together many top scientists working in this field by encouraging society membership, organizing conferences, and writing a

monthly news column. She retired from teaching and from the OSA in 1972, although she remained involved in professional activities for several more years.

Warga was named a Distinguished Daughter of Pennsylvania (1954) and Woman of the Year in Science Research (1959), and received a District Service Award in Applied Spectroscopy (1962). Upon her retirement, she was honored with a Distinguished Service Award from the OSA (1973). She was a member of the governing board of the American Institute of Physics beginning in 1960 and served as secretary of the Joint Council on Quantum Electronics. She was elected a fellow of the OSA, American Physics Society, Physics Society of London, and American Association for the Advancement of Science. She was a member of the U.S. and International Commission for Optics, American Association of Physics Teachers, American Chemical Society, and Society for Applied Spectroscopy.

Further Resources

Howard, John N. 2002. "An Executive Secretary for OSA." *Optics & Photonics News*. 13(6): 14–15. <http://www.opticsinfobase.org/abstract.cfm?URI=OPN-13-6-14>.

Washburn, Margaret Floy

1871–1939

Psychologist

Education: A.B., Vassar College, 1891, A.M., 1893; Ph.D., Cornell University, 1894

Professional Experience: professor, psychology and ethics, Wells College, 1894–1900; dean, Sage College, Cornell University, 1900–1902, lecturer, psychology, 1901–1902; assistant professor and head, psychology, University of Cincinnati, 1902–1903; associate professor, philosophy and psychology, Vassar College, 1903–1908, professor, psychology, 1908–1937

Margaret Washburn was recognized in the new field of experimental psychology, in particular for her research on a motor theory of consciousness, or the idea that all thoughts and perceptions produce some type of physical reaction. She merged her interests in science and philosophy in her work on social consciousness, emotions, animal psychology, and comparative psychology. She authored or co-authored (with her Vassar students) hundreds of scientific papers; her most important books were *The Animal Mind* (1908) and *Movement and Mental Imagery* (1916), which presented her theory of consciousness and linked different

schools of psychological thought at the time. Her name was included in a study of 50 eminent American psychologists in 1903.

Washburn earned a bachelor's and master's degree at Vassar, then applied to the doctoral program in psychology at Columbia University. Columbia would not admit a woman in the graduate program, however, so she went to Cornell University instead and received her Ph.D. in 1894. She spent six years as a professor of psychology and ethics at Wells College before returning to Cornell as a lecturer in psychology. She spent one year as an assistant professor and head of the psychology department at the University of Cincinnati before returning to her alma mater at Vassar College as associate professor of philosophy and psychology in 1903; she was promoted to full professor in 1908 and remained at Vassar until her retirement in 1937. Between 1925 and 1935, she served as co-editor of the *American Journal of Psychology*.

In 1931, Washburn was only the second woman (after **Florence Sabin**, 1925) to be elected to the National Academy of Sciences. She served as vice president of the American Association for the Advancement of Science and, in 1921, became president of the American Psychological Association. In 1929, she became a member of the Society of Experimental Psychologists, which had previously barred women from membership; two years later, the Society met at Vassar, a women's college, at Washburn's invitation.

Watson, Patty Jo (Andersen)

b. 1932

Anthropologist, Archaeologist

Education: B.A., University of Chicago, M.A., 1956, Ph.D., anthropology, 1959

Professional Experience: field assistant, Oriental Institute Iraq-Jarmo project, University of Chicago, 1954–1955; National Science Foundation (NSF) fellow, University of Michigan, 1957–1958; NSF fellow, University of Minnesota, 1958–1959; archaeologist and ethnographer, Oriental Institute, University of Chicago, 1959–1960, research associate, archaeology, 1964, 1967; assistant to associate professor, anthropology, Washington University, St. Louis, 1969–1973, professor, 1973–1993, distinguished university professor, 1993–

Concurrent Positions: instructor, anthropology, University of Southern California and Los Angeles State College, 1961; summer lecturer, anthropology, University of Michigan, Ann Arbor, 1962–1963; project associate, anthropology curriculum study project, American Anthropological Association, 1965–1967

Patty Jo Watson is a distinguished anthropologist and archaeologist who pioneered the field of ethnoarchaeology. Her research interests have ranged from the prehistory of Iran, to the archaeology of the Mammoth Cave area in Kentucky, to method and theory in shipwreck archaeology. Early in her career, she was a field assistant for the Oriental Institute of the University of Chicago, through which she was involved as an archaeologist and ethnographer on an Iranian prehistory project and directed the excavation of an ancient site in Turkey on behalf of the Istanbul-Chicago Joint Prehistoric Project. Her dissertation project was an investigation of early village farming in the Levant.

Married to an avid caver, she became interested in cave archaeology in North America and has conducted research in Kentucky, New Mexico, and Tennessee; this work has been supported by grants from the National Endowment for the Humanities and National Geographic Society. She is author of *Archaeology of the Mammoth Cave Area* (1974) and co-editor of the book, *Of Caves and Shell Mounds* (1996). She also co-authored *Archaeological Explanation: The Scientific Method in Archaeology* (1984) and co-edited *The Origins of Agriculture: An International Perspective* (1992), a collection of papers from a symposium of the American Association for the Advancement of Science at which all of the speakers were experts in crop evolution or the archaeological record for early plant cultivation. She has served on the editorial board of the journals *Anthropology Today*, *American Anthropologist*, and *American Antiquity*.

Watson was elected to membership in the National Academy of Sciences in 1988. She received the Fryxell Award for interdisciplinary research given by the Society for American Archaeology at a symposium on interdisciplinary research held in her honor in 1990, and in 1996 received a Distinguished Service Award of the American Association of Anthropology. She is a fellow of the American Anthropological Association and a member of the American Association for the Advancement of Science, Society for American Archaeology, Middle East Studies Association of North America, Cave Research Foundation, and the St. Louis Society, a branch of the Archaeological Institute of America. In 1995, she was featured in a three-part public television miniseries on women scientists called "Discovering Women."

Wattleton, (Alyce) Faye

b. 1943

Nurse-Midwife

Education: B.S., nursing, Ohio State University, 1964; M.S., maternal and infant healthcare, and certificate, nurse-midwifery, Columbia University, 1967

Professional Experience: instructor, Miami Valley School of Nursing, 1964–1966; assistant director, nursing, Dayton Public Health Nursing Association, 1967–1970; executive director, Planned Parenthood Association of Miami Valley, Dayton, Ohio, 1970–1978; president, Planned Parenthood Federation of America (PPFA), 1978–1992; host, syndicated television show, Chicago, 1992; president and founder, Center for Gender Equality, 1995; president, Center for the Advancement of Women, 1995–2010

Faye Wattleton was the first African American woman to serve as president of the PPFA. She led the nation's oldest and largest voluntary family-planning organization in a crusade to guarantee every person's right to decide if and when to have a child. With a background in nursing,

she became president of Planned Parenthood in 1978, believing that family planning is the best solution to a host of problems that are intensified by the high rate of unintended pregnancies. These problems include child abuse, teenage pregnancy, and sexually transmitted diseases, as well as poverty, hunger, and death and injury from unsafe abortions. She was inspired to work with Planned Parenthood on the local level in Dayton, Ohio, after seeing the number of girls and women who suffered or died from illegal or self-induced abortions. In the early twentieth century, Margaret Sanger founded the American birth-control movement and created an organization that was the forerunner of the PPFA. Continuing Sanger's vision of medical services as well as education and information, Planned Parenthood offers pregnancy diagnosis, prenatal care, infertility counseling, AIDS testing, and contraceptive services, as well as information on sexual health, not only in the United States but through international efforts as well.

In the 1960s and early 1970s, some black activists criticized Planned Parenthood as a white-managed agency whose mission was to reduce the black birthrate



Faye Wattleton, a former president of Planned Parenthood, has been a world leader in the struggle to safeguard women's reproductive rights. (Getty Images)

through population control. The selection of Wattleton as president expanded the vision and operation of Planned Parenthood. New controversies arose in the 1980s and 1990s with an active anti-abortion movement's attacks on patients and clinics, and even death threats sent to Wattleton personally. The courts continued to address the abortion issue, and setbacks to the pro-choice movement came in the form of decreased funding and efforts to limit abortion rights through parental notification or waiting periods. Throughout her presidency, Wattleton (like her successors) emphasized Planned Parenthood's message of education and choice. She resigned as president in 1992 but remained active as a public figure through hosting a television show and in her work with various organizations on a range of women's issues.

Wattleton has received numerous awards, including the American Humanist Association's Humanist of the Year (1986), Claude Pepper Humanitarian Award (1990), Boy Scouts of America Award (1990), Spirit of Achievement Award of the Albert Einstein College of Medicine, Yeshiva University (1991), Margaret Sanger Award (1992), Jefferson Public Service Award (1991), and Dean's Distinguished Service Award of the Columbia School of Public Health (1992). In addition to her scientific papers, she has written a book, *How to Talk to Your Child about Sexuality* (1986), and her autobiography, *Life on the Line* (1996).

Further Resources

Faye Wattleton. <http://www.fayewattleton.com/>.

Way, Katharine

1903–1995

Physicist

Education: B.S., Columbia University, 1932; Ph.D., physics, University of North Carolina, 1938

Professional Experience: research fellow, Bryn Mawr College, 1938–1939; instructor, physics, University of Tennessee, 1939–1941, assistant professor, 1941–1942; physicist, Naval Ordnance Laboratory, 1942; physicist, Oak Ridge National Laboratory, 1942–1948; physicist, National Bureau of Standards, 1949–1953; director, nuclear data project, National Research Council (NRC), 1953–1963; director, Oak Ridge National Laboratory, 1964–1968; editor, *Nuclear Data Tables*, 1965–1973; editor, *Atomic Data*, 1969–1973; editor, *Atomic Data and Nuclear Data Tables*, 1973–1982; director, surgery and bioengineering, National Institutes of Health (NIH) study section, 1981–1985

Concurrent Positions: adjunct professor, physics, Duke University, 1968–1988

Katharine Way was a physicist whose research included nuclear fission, radiation shielding, and nuclear constants. One of her most notable contributions to science, however, was the vast project of compiling and editing the *Atomic Data and Nuclear Data Tables*, a journal of regularly updated research information for experimental and theoretical physicists that is now available online. Way was in on the ground floor of the entire project during World War II, when she was involved in the Manhattan Project at the Naval Ordnance Laboratory, the Oak Ridge National Laboratory, and the National Bureau of Standards. She had been a research fellow at Bryn Mawr College and then on the faculty at the University of Tennessee. She moved to Washington, D.C., during the war and worked at various laboratories on nuclear physics. She worked with Eugene Wigner on what became known as the Way-Wigner formula on the decay of nuclear fission products; Wigner was later awarded the Nobel Prize in Physics.

Way's work in nuclear physics led to her concern about the ethical uses and threat of the atomic bomb. In 1946, she co-edited a book, *One World or None: A Report to the Public on the Full Meaning of the Atomic Bomb*, which included essays by top scientists of the era (including Albert Einstein) and became a *New York Times* bestseller; the book has been reprinted numerous times, most recently in 2007. After the war, she worked for the National Bureau of Standards and then as director of the nuclear data project for the NRC, where she served as editor of the new publications for collecting and organizing research data. She and other physicists began compiling the "Nuclear Data Sheets" in 1964 and, after the project moved to Oak Ridge National Laboratory, they published the first issue of the new journal. The project culminated in the combined *Atomic Data and Nuclear Data Tables*, which Way worked on from 1965 to 1982, leaving to accept a directorship at the NIH. During this time, she also spent 20 years as adjunct professor of physics at Duke University. Way was an elected fellow of the American Physical Society and the American Association for the Advancement of Science.

Weertman, Julia (Randall)

b. 1926

Solid-State Physicist, Metallurgist

Education: B.S., Carnegie Institute of Technology, 1946, M.S., 1947, D.Sc., physics, 1951

Professional Experience: Rotary International fellow, École Normale Supérieure, University of Paris, 1951–1952; physicist, U.S. Naval Research Laboratory, 1952–1958; visiting assistant professor, Northwestern University, Illinois, 1972–1973, assistant to associate professor, materials science, 1973–1981, professor, 1982–1987, director, Material Science and Engineering Department, 1987–1992

Julia Weertman is renowned for her research on high-temperature metal failure and the nanocrystalline structures of metals. Her research includes dislocation theory, high-temperature fatigue, small-angle neutron scattering, and nanocrystalline material. She has also contributed to the understanding of the basic characteristics of different materials in her research on small-angle neutron scattering. She received all of her degrees at the Carnegie Institute of Technology (now part of Carnegie-Mellon University). After completing postdoctoral studies at the École Normale Supérieure, she was appointed to a position as a physicist at the U.S. Naval Research Laboratory. Her work there centered on ferromagnetic spin resonance and the study of the basic concepts of magnetism. She interrupted her formal research to accompany her husband to London, where he worked for the Naval Research Laboratory. She and her husband, Johannes Weertman, collaborated on a textbook during this period, *Elementary Dislocation Theory* (1964). When they returned to the United States, her husband accepted a position at Northwestern University, and she took several years off from her career to raise children.

Weertman returned to research formally when she joined Northwestern in 1972 as a visiting assistant professor, then rose through the ranks to full professor, director of the materials science and engineering program, and a distinguished professorship by the time she retired in 1992. She has been an advisor to several government agencies, including the National Science Foundation, Department of Energy, National Bureau of Standard and Technology, and Argonne and Oak Ridge National Laboratories.

Weertman was elected to membership in the National Academy of Engineering in 1988. In addition to her scientific papers, she has been co-author of six books. She was a member of the Evanston (Illinois) Environmental Control Board (1972–1979) and a member of the National Research Council's National Materials Advisory Board (1999–2005). She has received a number of awards, including the Creativity Award of the National Science Foundation (1981 and 1986), a Guggenheim fellowship (1986), the Distinguished Engineering Educator Award of the Society of Women Engineers (SWE) (1989), an Achievement Award of SWE (1991), the Leadership Award of the Minerals, Metals, and Materials Society (TMS) (1996), the Von Hippel Award of Materials Research Society (2003), and

the Gold Medal of American Society for Metals (ASM) International (2005). She is a fellow of the American Academy of Arts and Science and a member of the American Institute of Physics, American Crystallographic Association, American Society for Testing and Materials, Materials Research Society, and American Physical Society.

Further Resources

Northwestern University. Faculty website. <http://www.matsci.northwestern.edu/faculty/jrw.html>.

Weisburger, Elizabeth Amy (Kreiser)

b. 1924

Biochemist, Toxicologist

Education: B.S., chemistry, Lebanon Valley College, 1944; Ph.D., organic chemistry, University of Cincinnati, 1947

Professional Experience: research associate, University of Cincinnati, 1947–1949; postdoctoral research fellow, National Cancer Institute, National Institutes of Health, 1949–1951, researcher, Biochemistry Laboratory, 1951–1961, Carcinogen Screening Section, Experimental Pathology, 1961–1973, chief, Carcinogen Metabolism and Toxicology, Division of Cancer Cause and Prevention, 1973–1981, assistant director, Chemical Carcinogenesis, Division of Cancer Etiology, 1981–1988; consultant, 1989–

Elizabeth Weisburger had a distinguished career as a toxicologist with the National Cancer Institute (NCI), where she conducted pioneering research on the carcinogenic effects of chemicals, pharmaceuticals, food additives, and environmental pollutants. Her research has aided in providing insight at the molecular level of carcinogenesis, which is vital in developing methods for the treatment and prevention of cancer. Among the compounds that she has studied are fluorenes, nitrosamines, aromatic amines, halogenated hydrocarbons, fumigants, and food preservatives. She has also investigated the relationship between mutagens and cancers, and emphasized developing improved test systems for evaluating carcinogenic risk. She was among the first scientists to test some of the drugs used in clinical cancer chemotherapy and to point out their potential dangers.

Weisburger was originally interested in biology as an undergraduate, but changed her major to chemistry, and studied mathematics and physics as well. During World War II, graduate assistantships in chemistry were readily available

to women because so many men were in the military service. Weisburger received an assistantship at the University of Cincinnati, Ohio, where she began work in cancer research and continued working as a research associate after graduation. She and her husband, medical researcher John H. Weisburger, then joined the NCI, where they collaborated until their divorce in 1974; he later became research director of the American Health Foundation. Elizabeth Weisburger published more than 200 papers on cancer-causing chemicals, nutrition, and other topics, and for many years was editor of the *Journal of the National Cancer Institute*. She retired from the NCI in 1988 and became a consultant, including as an advisor on project funding for the American Institute of Cancer Research, and as a senior associate with Mandava Associates, a consulting firm that advises biotechnology, pharmaceutical, and related companies on compliance with government safety, environmental, and other regulations.

Weisburger has been a member of the Chemical Substances Committee of the American Conference of Government Industrial Hygienists since 1978. She has received honorary degrees from the University of Cincinnati (1981) and from Lebanon Valley College (1989). Her numerous awards include the Meritorious Service Medal (1973) and Distinguished Service Medal (1985) of the U.S. Public Health Service, the Garvan Medal of the American Chemical Society (1981), the Hillebrand Prize of the Chemical Society of Washington (1981), and the Herbert E. Stokinger Award of the American Conference of Governmental Industrial Hygienists (1996). She is a member of the American Association for the Advancement of Science, American Association for Cancer Research, American Chemical Society, Society of Toxicology, American Society of Biochemistry and Molecular Biology, and Royal Society of Chemistry.

Weisstein, Naomi

b. 1939

Psychologist

Education: B.A., Wellesley College, 1961; Ph.D., psychology, Harvard University, 1964

Professional Experience: lecturer, University of Chicago, 1965; assistant to associate professor, Loyola University, Chicago, 1966–1973; professor, psychology, State University of New York at Buffalo, 1973–emerita

Concurrent Positions: consultant, Xerox Corporation, 1973–1974

Naomi Weisstein is an experimental psychologist known for her research in vision, perception, and cognition. She is also known for her activity in civil rights and feminist causes starting in the 1960s, first as a graduate student at Harvard and then as a postdoctoral lecturer at the University of Chicago. She was one of the first women to speak out about employment practices in academia and, specifically, on the difficulties of women entering the scientific professions. Weisstein attended the Bronx High School of Science and went on to Wellesley College as an undergraduate, where she took for granted the dedicated female professors who had received degrees from first-class universities, not realizing many of them were teaching at a women's college because they were unable to secure positions at other universities. Such faculty members often had heavy teaching loads and little time, equipment, or funds to conduct scientific research. Weisstein went on to Harvard, where the department chair told first-year graduate students that women did not belong in graduate school and restricted women's use of lab equipment. She attended Yale University briefly to use their equipment and transferred her credits and work back to Harvard in order to receive her doctorate in psychology in 1964.

Weisstein was promised a position at the University of Chicago, but about 10 days before classes started, the department invoked an unwritten anti-nepotism rule to deny her a position because her husband, Jesse Lemisch, was a faculty member. She was hired instead as a lecturer to teach in areas outside her research and, after one year, was notified that her contract would not be renewed. She then obtained a tenure-track faculty position at Loyola University in Chicago, where she taught for seven years before both she and her husband relocated for faculty positions at the State University of New York at Buffalo.

One of Weisstein's research interests was the discipline of psychology itself, and the way it describes male and female personalities differently in ways that disadvantage women. She has also questioned the effectiveness of psychotherapy and the clinical definitions of schizophrenia, homosexuality, and even heterosexuality. In a landmark 1968 paper, "Psychology Constructs the Female," she argued that psychology provides little insight into woman's true "nature," instead defining women according to sexist ideas of desired social roles as wives and mothers, and finding them psychologically unstable when they do not fulfill those roles. She went on to write dozens of scientific papers, but by the early 1980s, Weisstein was struck with physical health problems and forced into early retirement. Although bedridden, she continued for some years to write, collaborate, consult, and sit on the editorial board of scientific journals.

In 1970, Weisstein, along with Phyllis Chesler and others, helped found American Women in Psychology. She also founded the Women's Caucus of the Psychonomic Society (1972) and Women in Eye Research (1980), a caucus of the Association

for Research in Vision and Ophthalmology. She has been a member of the Optical Society of America, American Association for the Advancement of Science, and American Psychological Association.

Further Resources

Lemisch, Jesse and Naomi Weisstein. 1997. "Remarks on Naomi Weisstein." <http://www.uic.edu/orgs/cwluherstory/CWLUMemoir/weisstein.html>.

Weisstein, Naomi. 2003. "Adventures of a Woman in Science." In *Autobiographical Writings Across the Disciplines*, edited by Diane P. Freedman and Olivia Frey, 397–413. Durham, NC: Duke University Press.

Westcott, Cynthia

1898–1983

Plant Pathologist

Education: B.A., Wellesley College, 1920; Ph.D., plant pathology, Cornell University, 1932

Professional Experience: science teacher, Northboro High School, Massachusetts, 1920–1921; assistant in plant pathology, Cornell University, 1921–1923, instructor, 1923–1925, research assistant, 1925–1931; assistant horticulturist, seed laboratory, New Jersey Experiment Station, 1931–1933; independent horticulturist, The Plant Doctor, New Jersey, 1931–1961; independent writer and lecturer, New York, 1961–1983

Concurrent Positions: plant pathologist, U.S. Department of Agriculture (USDA), 1943–1945

Cynthia Westcott was a plant pathologist whose research focused on rose diseases, diseases of ornamental trees and flowers, and garden diseases and pests. She established a private practice as the "Plant Doctor" when she was unable to find a full-time professional position, and worked briefly for the USDA. As an independent plant consultant, she maintained the gardens of her wealthy customers, lectured at women's clubs, and published several books: *The Plant Doctor: The How, Why and When of Disease and Insect Control in Your Garden* (1937), *The Gardener's Bug Book* (1946), *Anyone Can Grow Roses* (1952), *Garden Enemies* (1953), and *Are You Your Garden's Worst Pest?* (1961). Many of her books went through numerous editions, including *Westcott's Plant Disease Handbook*, originally published in 1950 and released in a seventh edition in 2008. She also wrote an

autobiography, *Plant Doctoring Is Fun* (1957), and wrote articles for popular magazines and newspapers, as well as leaflets on pesticides for the Manufacturing Chemists Association.

Westcott received her Ph.D. in plant pathology from Cornell University in 1932. She had previously taught high school science courses and spent 10 years working on her doctorate at Cornell, supporting herself by working as a research assistant and instructor. She worked in the seed laboratory at the New Jersey Experiment Station for three years before setting up her own business. During World War II, she worked as a plant pathologist for the USDA in order to earn money to obtain the supplies she needed for her business.

Westcott's work was honored with a citation from the American Horticultural Council (1955), a Gold Medal from the American Rose Society (1960), a Gold Medal from the Garden Club of New Jersey, and a Garden Writers Award from the American Association of Nurserymen (1963). She was active in professional scientific and gardening organizations, and was the first president of the North Jersey Rose Society (1954–1956) and director of the American Rose Society (1954–1960), and served as committee chair for the American Rose Foundation and the National Council of State Garden Clubs. She was a fellow of the American Association for the Advancement of Science and a member of the American Phytopathological Society, American Association of Economic Entomologists, American Entomological Society, American Horticultural Society, and Garden Writers Association of America, and an honorary life member of the Garden Club of New Jersey.

Further Resources

Horst, R. K. 1984. "Pioneer Leaders in Plant Pathology: Cynthia Westcott, Plant Doctor." *Annual Review of Phytopathology*. 22: 21–26. (September 1984). <http://arjournals.annualreviews.org/doi/abs/10.1146/annurev.py.22.090184.000321?cookieSet=1&journalCode=phyto>.

West-Eberhard, Mary Jane

b. 1941

Entomologist

Education: B.A., University of Michigan, 1963, M.S., 1964, Ph.D., zoology, 1967

Professional Experience: teaching fellow, zoology, University of Michigan, 1963–1965; fellow, biology, Harvard University, 1967–1969; associate entomologist, Smithsonian Tropical Research Institute, 1973–1975, entomologist, 1975–

Concurrent Positions: staff member, biology, University of Valle, Colombia, 1972–1978; distinguished visiting scientist, Museum of Zoology, University of Michigan, 1982

Mary Jane West-Eberhard is a renowned entomologist who has studied the evolution of social behavior in insects of all types, primarily in Central and South America. She has published papers on insects' chemical communication, scent trails, social behavior, and diversity. She has theorized that evolved traits such as cyclic reproductive behavior, aggressiveness, and group life presumably reflect the genetic makeup of the individuals performing them. It seems that even caste determination, according to which some individuals end up as helpers and others as egg-laying queens, depends to some degree on heritable differences in aggressiveness, for example, especially in relatively simple societies in which there is no extensive manipulation of the brood, which can overwhelm heritable variation. She is the co-editor of *Natural History and Evolution of Paper-Wasps* (1996), which is based on a workshop held in Italy in 1993 to celebrate the fiftieth anniversary of Leo Pardi's original description of dominance hierarchies. In her chapter in the volume, she discusses how the differentiation of paper-wasp behavior and physiology may provide an illuminating model for some of the largest questions concerning the interface between development and evolution.

West-Eberhard was elected to membership in the National Academy of Sciences in 1988. Her 2003 book, *Developmental Plasticity and Evolution*, won the R. R. Hawkins Award of the American Association of Publishers for Outstanding Professional, Reference or Scholarly Work. Soon after the book's publication, she was awarded the 2003 Sewall Wright Award of the American Society of Naturalists. In 2005, she received a prestigious international honor when she was elected to Italy's Accademia Nazionale dei Lincei, the oldest scientific society in the world. She has been a member of several distinguished committees and commissions, including the International Committee for the International Union for the Study of Social Insects, the Organization for Tropical Studies, and the advisory committee of the Monteverde Conservation League Committee on Human Rights of the National Academy of Sciences. She is a member of the American Society of Naturalists, and Society for the Study of Evolution (president, 1992).

Further Resources

Smithsonian Tropical Research Institute. "Mary Jane West-Eberhard." http://www.stri.org/english/scientific_staff/staff_scientist/scientist.php?id=35.

Westheimer, (Karola) Ruth (Siegel)

b. 1928

Psychologist

Education: degree, psychology, University of Paris, Sorbonne; M.S., sociology, New School for Social Research, 1959; Ed.D., Columbia University, 1970

Professional Experience: research assistant, Columbia University School of Public Health, 1967–1970; associate professor, Department of Sex Counseling, Lehman College, 1970–1977; radio talk show host, television show host, author, private practice in psychology, 1980–1997, independent author and lecturer, 1997–

Concurrent Positions: adjunct professor, New York University; associate fellow, Calhoun College, Yale University; fellow, Butler College, Princeton University

Ruth Westheimer is popularly known as “Dr. Ruth,” a psychologist and sex therapist who has appeared on hundreds of television and radio shows, and who has written numerous books for the general public. She is a trained counselor and also



American psychologist and sex therapist, Ruth Westheimer, 2007. Dr. Ruth has appeared on hundreds of television and radio shows, and written numerous books for the general public. (AP/Wide World Photos)

maintained a private practice for a number of years. She pioneered the call-in radio and television era of media psychology shows with her show, *Sexually Speaking*, which began in 1980. For more than 20 years, she has engaged the public on controversial subjects related to sexuality, sexual dysfunction, marriage, and relationships. She has joked that her German accent allows her, a diminutive older woman, to call body parts and functions by their proper name and to advise both men and women, and that the American public would not have accepted her if she had an English or American accent. Although formally retired in 1997, she still travels, gives talks, teaches university courses on the family and sexuality, makes television and documentary appearances, and maintains a website.

Karola Ruth Siegel was born in Frankfurt, Germany in 1928. When she was 10 years old, her parents decided to flee Germany, but sent Ruth to a children's refuge in Switzerland. Her father was arrested before she left, and she presumes all of her family died in the concentration camps. Since the school considered her a welfare case, she was trained only as a maid. After the war, she emigrated to Palestine and joined Haganah, an underground movement fighting for the creation of a Jewish homeland. She dreamed of becoming a physician, but without family support and money, it was an impossible dream. She married and accompanied her first husband to Paris, where he studied medicine and she received a degree in psychology from the Sorbonne. She was divorced and remarried a Frenchman, whom she accompanied to New York in 1956 with their young daughter. After divorcing again, she attended evening classes for a master's degree at the New School for Social Research and went on for a doctorate of education from Columbia University Teachers College. In 1961, she married her third husband, Manfred Westheimer, and had another child. She had a position at Lehman College in the Department of Sex Counseling for a time and then worked for Brooklyn College and a few other schools.

After giving a lecture to a group of New York broadcasters about the need for sex education programming, she was invited in 1980 to tape a 15-minute radio show, *Sexually Speaking*. She was immediately popular and went on to nationally and internationally syndicated newspaper columns and award-winning television shows such as *The Dr. Ruth Show*, *Ask Dr. Ruth*, and *What's Up, Dr. Ruth?*, a show for teens. Her career as an author began with *Dr. Ruth's Guide to Good Sex* (1983). She went on to publish more than 30 titles, including *Dr. Ruth's Guide to Safer Sex* (1992), *Dr. Ruth's Encyclopedia of Sex* (1994; now available completely online), *Sex for Dummies* (1996; 3rd ed., 2006), *Rekindling Romance for Dummies* (2001), *Human Sexuality: A Psychosocial Perspective* (2002, co-authored with Sanford Lopater), and *Dr. Ruth's Guide to Talking about Herpes* (2004, co-authored with Pierre A. Lehu). Her autobiography is *All in a Lifetime* (1987).

Westheimer is a fellow of the New York Academy of Medicine and has received honorary doctorates from Hebrew Union College (2000), City University of

New York, Lehman College (2001), Trinity College (2004), and Westfield State College (2008). Her most recent awards include the Ellis Island Medal of Honor and the Leo Baeck Medal of the International Society for Sexual and Impotence Research, both in 2002, and a 2006 Medal for Distinguished Services from Columbia University Teachers College. In 2009, *Playboy* magazine named her one of the “55 Most Important People in Sex” of the past 55 years.

Further Resources

Dr. Ruth. <http://www.drruth.com>.

Wexler, Nancy Sabin

b. 1945

Neuropsychologist

Education: B.A., Radcliffe College, 1967; Ph.D., clinical psychology, University of Michigan, 1974

Professional Experience: intern and teaching fellow, University of Michigan, Ann Arbor, 1968–1974; assistant professor, psychology, New School of Social Research, New York City, 1974–1976; executive director, Congressional Commission for Control of Huntington’s Disease, National Institute of Neurology, National Institutes of Health (NIH), 1976–1978, health science administrator, 1978–1983; associate professor, clinical neuropsychology, College of Physicians and Surgeons, Columbia University, 1985–1992, professor, 1992–

Concurrent Positions: psychologist, private practice, 1974–1976; president, Hereditary Disease Foundation, Santa Monica, California, 1983–

Nancy Wexler is renowned as one of the primary leaders in the fight to discover the cause of and cure for the hereditary Huntington’s disease, named for George Huntington, a physician who identified the disease in 1872. The disease appears in middle age and slowly kills nerve cells in the brain, causing dementia and rapid, uncontrollable movements of the joints and limbs. Patients live an average of 15 years after the symptoms first appear. In 1968, when she was in graduate school at the University of Michigan, Wexler learned that her mother had developed symptoms of the disease, which had killed her grandfather and three of her uncles. Her mother’s illness meant that both Nancy and her sister had a 50% chance of having inherited the defective gene that causes the disease—and that they might pass it on if they ever had children. Her father, a psychoanalyst, founded the Hereditary Disease Foundation in order to support research; Nancy assumed the presidency of the Foundation in 1983.

Wexler received her doctorate in 1974 and wrote her dissertation on the neuro-psychological and emotional consequences of being at risk for Huntington's disease. She was executive director of the Congressional Commission for the Control of Huntington's Disease through the NIH. She also helped to organize the Huntington's Disease Collaborative Research Group in 1984, an international consortium of scientists whose mandate was to track down the gene. The gene was isolated in 1993, but unfortunately, there is not yet a treatment for the disease. She has been a member of government committees concerned with ethical, legal, and social issues in medicine, and advisor to several groups related to the Human Genome Project, an international effort to map and identify the approximately 25,000 genes in the human body.

In 1997, Wexler was elected to the Institute of Medicine of the National Academies of Science. She has received several honorary medical doctorates and was awarded the Albert Lasker Public Service Award (1993) for her efforts connected with finding a cure for Huntington's disease. A partial listing of her numerous other awards includes an Alumnae Athena Award from the University of Michigan (1989), Venezuelan Presidential Award (1991), Distinguished Service Award of the National Association of Biology Teachers (1993), National Medical Research Award of the National Health Council (1993), J. Allyn Taylor International Prize in Medicine (1994), Public Advocacy Award of the Society for Neuroscience (2003), Distinguished Investigator Award of NARSAD (National Alliance for Research on Schizophrenia and Depression) (2006), and Benjamin Franklin Medal in Life Science (2007). She is a fellow of the Royal College of Physicians, American Academy of Arts and Sciences, and New York Academy of Sciences, and has been a member of the American Psychological Association, American Society for Human Genetics, American Neurological Association, American Society of Law and Medicine, Society for Neuroscience, and World Federation of Neurology.

Further Resources

Hereditary Disease Foundation. "Meet Nancy Wexler." <http://www.hdfoundation.org/bios/nancyw.php>.

Wheeler, Anna Johnson Pell

1883–1966

Mathematician

Education: A.B., University of South Dakota, 1903; M.A., University of Iowa, 1904; A.M., Radcliffe College, 1905; Ph.D., mathematics, University of Chicago, 1910

Professional Experience: instructor, mathematics, Mount Holyoke College, 1911–1914, associate professor, 1914–1918; associate professor, Bryn Mawr College, 1918–1925, department chair, 1924–1948, professor, 1925–1927, non-research professor, 1929–1932, professor, 1932–1948

Anna Pell Wheeler was a distinguished research mathematician whose work was primarily in the area of linear algebra of infinitely many variables and integral equations. She was only the second woman to receive a doctorate in mathematics at the University of Chicago, and was one of the few professional women mathematicians recognized in the early twentieth century. She graduated from the University of South Dakota in 1903 and went on to obtain master's degrees from both the University of Iowa and Radcliffe. She received a one-year fellowship to study at the University of Göttingen (1906–1907), then returned to South Dakota, where she married one of her former mathematics professors and taught some classes. The couple moved to Chicago, where she completed her doctorate in mathematics in 1910. When her husband suffered a paralytic stroke, she substituted for him at the Armour Institute of Technology, but she was unable to obtain a position there. She accepted a position at Mount Holyoke in 1911 in order to support them, but she did not have time for her research. She moved to Bryn Mawr as an associate professor in 1918, served as head of the department, and was promoted to professor in 1925, the same year she married her second husband, Arthur Wheeler, a classics professor. They moved to Princeton, New Jersey, but she continued to teach at Bryn Mawr on a part-time basis. When her husband died in 1932, she returned to full-time work at Bryn Mawr, retiring in 1948.

During her 30-year affiliation with Bryn Mawr, Wheeler encouraged female students to pursue mathematics and advised several who went on to earn doctoral degrees. In addition to her teaching and research, Wheeler was active in professional mathematical associations and was an editor of the *Annals of Mathematics* for almost 20 years. She received honorary degrees from the New Jersey College for Women (1932) and Mount Holyoke College (1937). In 1927, she was the first woman invited to give the American Mathematical Society Colloquium Lecture; the next female lecturer was not until 1980. Wheeler was a member of the American Mathematical Society, the Mathematical Association of America, and the American Association for the Advancement of Science.

Further Resources

Agnes Scott College. "Anna Johnson Pell Wheeler." Biographies of Women Mathematicians. <http://www.agnesscott.edu/lriddle/women/wheeler.htm>.

Wheeler, Mary F.

b. 1931

Mathematician, Engineer

Education: B.S., social sciences and math, University of Texas, Austin, 1960, M.A., mathematics, 1963; Ph.D., mathematics, Rice University, 1971

Professional Experience: instructor, mathematics, Rice University, 1971–1973, assistant to associate professor, mathematical sciences, 1973–1980, professor, 1980–1988; M.D. Anderson Professor of Mathematics, University of Houston, 1988–1990; Noah Harding Professor of Computational and Applied Mathematics, Rice University, 1988–1995; Ernest and Virginia Cockrell Chair in Engineering, University of Texas, Austin, 1995–, professor, mathematics, aerospace engineering, and petroleum and geosystems engineering, 1995–

Concurrent Positions: adjunct professor, University of Texas M. D. Anderson Cancer Center; affiliated senior scientist, University of Houston, 1990–

Mary Wheeler is a mathematician whose research links theory and application in a focus on numerical solutions of partial differential equations, parallel computation, and modeling subsurface and surface flows. Specifically, her work has had industry-related applications to projects in oil recovery, reservoir engineering, and solutions for reducing pollutants in groundwater, bays, and estuaries. Born in Texas, she received her doctorate in mathematics from Rice University in 1971 and has taught at several Texas institutions, including Rice and the University of Houston, and, since 1995, has been a faculty member at the University of Texas, Austin. She is also the director of the Center for Subsurface Modeling in the Texas Institute for Computational and Applied Mathematics (TICAM). She is the author of hundreds of scientific technical papers and has edited or co-edited several books. She has also served on the editorial board of several professional journals, including *Computational Geosciences*.

Wheeler began her college career with interests in pharmacology, or government and law. But her passion was in math, and she held a double major in social sciences and mathematics while an undergraduate at the University of Texas. She went on to study math at the graduate level and became interested in physical and engineering applications rather than theory and economics.

She was invited to give the prestigious Emmy Noether Lecture in 1989 and has been an invited lecturer at universities and organizations around the world. She has served on committees on science policy, industrial mathematics, and science education, and mathematical sciences and research review committees for

government organizations such as the National Science Foundation, Argonne and Oak Ridge National Laboratories, and U.S. Department of Energy.

Wheeler was elected to the National Academy of Engineering in 1998. Among her numerous awards and honors is an Educator Award from American Women in Aerospace (1997), Distinguished Alumna Award from Rice University (2000), USACM Computational Fluid Mechanics Award (2003), Joe J. King Award from the University of Texas at Austin (2006), and several IBM Faculty Recognition Awards (2006, 2007, 2008). She has also received honorary doctorates from Technische Universiteit Eindhoven (2006) and the Colorado School of Mines (2008). She is a member of the Mathematical Association of America, American Geophysical Union, Society of Industrial and Applied Mathematics (SIAM), Society of Petroleum Engineers (SPE), and American Women in Mathematics, and a fellow of the International Association for Computational Mechanics.

Further Resources

Agnes Scott College. "Mary F. Wheeler." Biographies of Women Mathematicians. <http://www.agnesscott.edu/lriddle/women/mwheeler.htm>.

University of Texas. Faculty website. <http://users.ices.utexas.edu/~mfw/>.

Whitman, Marina (von Neumann)

b. 1935

Economist

Education: B.A., government, Radcliffe College, 1956; M.A., economics, Columbia University, 1959, Ph.D., economics, 1962

Professional Experience: administrative assistant, Educational Testing Service, 1956–1957; consultant, Pittsburgh Regional Planning Association, 1961, staff economist, Economic Study of the Pittsburgh Region, 1962; lecturer, economics, University of Pittsburgh, 1962–1964, assistant to associate professor, 1964–1971, professor, 1971–1973, Distinguished Public Service Professor of Economics, 1973–1979; vice president and chief economist, General Motors (GM) Corporation, New York, 1979–1985, vice president and group executive, public affairs and marketing staff, 1985–1992; distinguished visiting professor, business administration and public policy, University of Michigan, Ann Arbor, 1992–1994, professor, 1994–

Concurrent Positions: fellow, Center for Advanced Study in the Behavioral Sciences, Stanford University, 1978–1979

Marina v. N. Whitman is a renowned international economist who has worked in business, education, and government. She has served as a senior staff economist for the Council of Economic Advisers, its first woman member, and she was the only woman member of the National Price Commission. She earned her doctorate in economics from Columbia University in 1962 and subsequently joined the faculty at the University of Pittsburgh. She rose quickly through the ranks to full professor, but left academia in 1979 to join GM as vice president and chief economist in charge of economic and environmental policy and industry–government relations. She left GM in 1992 to return to teaching at the University of Michigan, Ann Arbor. In all of her work, in teaching, business, or as a government advisor, Whitman has advocated for a greater global vision and international economic role for the United States.

As the only daughter of the eminent mathematician John von Neumann, she grew up in an atmosphere of stimulating people. Many famous people visited her family home, and she had tremendous intellectual drive and intense pressure to achieve as an undergraduate at Radcliffe. She married after graduation and, in order to be near her husband's job at Princeton, worked as an administrative assistant for Educational Testing Service, a nonprofit organization specializing in educational measurement and research. She then enrolled in Columbia University, planning to receive a master's degree in economics and journalism, and to pursue a career in financial writing. Instead, she concentrated on economic theory and, as part of her graduate studies, prepared an economic development plan for the Pittsburgh Regional Planning Association. She then accepted an appointment as a lecturer in economics at the University of Pittsburgh. In 1970, she was selected as a member of the prestigious Council of Economic Advisers under President Nixon. In this role, Whitman made a special report on women in the American economy, stating that, despite 10 years of civil rights legislation, women had made little progress toward job equality with men; in 1971, the average female worker earned only 59.5 cents on the male dollar for comparable work. She later served on President Carter's Economic Advisory Committee.

Whitman has published numerous articles and books, including *Government Risk-Sharing in Foreign Investment* (1965), *Reflections of Interdependence: Issues for Economic Theory and U.S. Policy* (1979), *New World, New Rules: The Changing Role of the American Corporation* (1999), and *American Capitalism and Global Convergence* (2003). She has examined the effect of global markets on American corporations and society, and advocated for an open market economy. She has been a member of several government committees, including the President's Council of Economic Advisors (1970–1973), National Price Commission (1971–1972), Economic Advisory Committee of the U.S. Department of Commerce (1979–1980), Commission on Security and Economic Assistance (1983–1984), President's Export

Council (1986–1987), and President’s Advisory Committee on Trade Policy and Negotiations (1987–1993). She has also been a board member or trustee of numerous national, international, and academic advisory committees.

Whitman has been awarded honorary doctorates from more than 20 universities and is the recipient of a Columbia University Medal for Excellence (1973 and 1984), the George Washington Award of the American Hungarian Foundation (1975), the Catalyst Award for women in business (1976), a Women’s Equity Action League Achievement Award (1979), and the William F. Butler Memorial Award of the New York Association of Business Economists (1988). She is a member of the American Economic Association, National Association of Business Economists, and Council on Foreign Relations, and a fellow of the American Academy of Arts and Sciences.

Further Resources

University of Michigan. Faculty website. <http://www.bus.umich.edu/FacultyBios/FacultyBio.asp?id=000119718>.

Whitson, Peggy A.

b. 1960

Astronaut

Education: B.S., biology and chemistry, Iowa Wesleyan College, 1981; Ph.D., biochemistry, Rice University, 1985

Professional Experience: Robert A. Welch postdoctoral fellow, Rice University, 1986; National Research Council Resident Research Associate, National Aeronautics and Space Administration (NASA) Johnson Space Center, Houston, Texas, 1986–1988; supervisor, Biochemistry Research Group, KRUG International, 1988–1989; research biochemist, Biomedical Operations and Research Branch, NASA Johnson Space Center, 1989–1993, deputy division chief, Medical Sciences Division, 1993–1996, astronaut, 1996–, deputy chief, Astronaut Office, 2003–2005, chief, Station Operations Branch, Astronaut Office, 2005

Concurrent Positions: adjunct assistant professor, Departments of Internal Medicine and Human Biological Chemistry and Genetics, University of Texas Medical Branch, Galveston, 1991–1997; adjunct assistant professor, Maybee Laboratory for Biochemical and Genetic Engineering, Rice University, 1997–

Peggy Whitson is a biochemist and astronaut who was the first woman commander of the International Space Station (ISS). She logged two long-term stays at the



Astronaut Peggy Whitson preparing for the launch of the Space Shuttle *Endeavour* on a mission to the International Space Station, 2002. (NASA)

ISS, in 2002 and 2007, and has accumulated more than 377 days in space and almost 40 hours of space walks, more than any other female astronaut. Whitson completed her doctorate in biochemistry at Rice University in Houston, Texas, and was a research associate at NASA before working briefly for KRUG International, a NASA-contracted medical sciences company. She returned to NASA in 1989 in Biomedical Operations and Research, and became a member of the U.S.–USSR Joint Working Group in Space Medicine and Biology, training astronauts in both the United States and Russia. Between 1992 and 1995, she was a project scientist on the Shuttle-Mir Program. She applied to the astronaut training program several years before being accepted in 1996. In 2002, she flew aboard the *Endeavour* for the Expedition-5 mission to dock with the ISS. She spent 6 months (nearly 185 days) with only

two other astronauts on the ISS as NASA Science Officer, conducting research on human biology and microgravity conditions. It was unusual for a first-time astronaut to be assigned such an extended mission, but her science research background, and her 10 years of NASA training on the ground, had prepared her well. In 2005, she began training as a backup ISS Commander and flew as Commander of the ISS for a second long-term stay (more than 191 days) with Expedition-16 in the fall of 2007.

Besides setting records for women in space, Whitson has been acknowledged for her numerous achievements at NASA, including but not limited to the following awards: Sustained Superior Performance Award (1990), Certificate of Commendation (1994), Exceptional Service Medal (1995, 2003, 2006), Silver Snoopy Award (1995), Space Act Board Award (1995, 1998), Group Achievement Award for Shuttle-Mir Program (1996), Space Flight Medal (2002), and Outstanding

Leadership Medal (2006). She was also awarded the Randolph Lovelace Award of the American Astronautical Society (1995).

Further Resources

National Aeronautics and Space Administration. "Peggy A. Whitson (Ph.D.)." <http://www.jsc.nasa.gov/Bios/htmlbios/whitson.html>.

Widnall, Sheila (Evans)

b. 1938

Aeronautical Engineer

Education: B.S., Massachusetts Institute of Technology, 1960, M.S., 1961, D.Sc., aeronautical engineering, 1964

Professional Experience: staff, Boeing, summers 1947–1959, 1961; staff, Aeronautical Research Institute of Sweden, summer 1960; research staff engineer, aerodynamics, Massachusetts Institute of Technology (MIT), 1961–1962, research assistant, 1962–1964, assistant to associate professor, aeronautics, 1964–1974, professor, 1974–1986, Abby Rockefeller Mauzé Professor and Chair, 1986–1993; Secretary of U.S. Air Force, 1993–1997; Institute Professor, aeronautics and astronautics, MIT, 1998–

Concurrent Positions: director, university research, U.S. Department of Transportation, 1974–1975; associate provost, MIT, 1992–1993; vice president, National Academy of Engineering, 1998–2006

Sheila Widnall is an aeronautical engineer whose research interests include unsteady aerodynamics, aeroelasticity, aerodynamic noise, turbulence, applied mathematics, vortex flows, numerical analysis, aerospace, transportation, aerodynamics and fluid mechanics, acoustics, and noise and vibration. She has been a professor of aeronautics and astronautics at MIT for more than 40 years, where her research has centered particularly on problems associated with fluid dynamics and air turbulence. Another area of research is the vortices of aircraft that make vertical, short takeoffs and landings (V/STOL), and the noise associated with them. One of her projects was to design an anechoic wind tunnel at MIT to study V/STOL aircraft—a wind tunnel that has a low degree of reverberation and is echo-free. In 1993, she became the first woman to head a branch of the U.S. military when she was selected to be Secretary of the U.S. Air Force. In this position, Widnall was responsible for recruiting, organizing, training, administration,

logistical support, maintenance, and welfare of personnel, as well as overseeing research and development projects outlined by the president or the Secretary of Defense. She co-chaired the Department of Defense Task Force on Sexual Harassment and Discrimination. She left the Air Force in 1997 to return to her faculty position at MIT.

As a young woman, she was encouraged by teachers and parents to pursue a career in science. Still, there were only 20 women in her class of about 900 at MIT. As president of the American Association for the Advancement of Science (1988), she was committed to encouraging more women to pursue careers in science and engineering, and outlined the problems they face in attaining their degrees and achieving professional goals. She has been an advisor for numerous government and industry projects and scientific agencies, including for the Carnegie Corporation, Sloan Foundation, Institute for Defense Analysis, Smithsonian Institution of Washington, Boston Museum of Science, GenCorp Inc., Chemfab Inc., Space and Aeronautics Board of the National Research Council, and National Science Foundation, to name just a few.

Widnall was elected to membership in the National Academy of Engineering in 1985 and was vice president of the National Academy of Engineering from 1998 to 2006. Her numerous awards and honors include the Lawrence Sperry Award of the American Institute of Aeronautics and Astronautics (1972), Outstanding Achievement Award of the Society of Women Engineers (1975), Washburn Award of the Boston Museum of Science (1986), Distinguished Service Award of the National Academy of Engineering (1993), Medal of Distinction from Barnard College (1994), W. Stuart Symington Award (1995) and Maxwell A. Kriendler Memorial Award (1995), both from the Air Force Association, Applied Mechanics Award of American Society of Mechanical Engineers (ASME) (1996), Distinguished Civilian Service Medals from both the Army and Navy (1997), Reed Aeronautics Award from American Institute of Aeronautics and Astronautics (AIAA) (2000), and Spirit of St. Louis Medal from ASME (2001). In 1996, she was inducted into the Women in Aviation Pioneer Hall of Fame. She is a fellow of the AIAA (president, 1999–2000), American Physical Society, Royal Aeronautical Society, and American Association for the Advancement of Science. She is a member of the Society of Women Engineers, American Society of Mechanical Engineers, Puerto Rican Academy of Sciences, International Academy of Astronautics, Institute of Electrical and Electronics Engineers (IEEE), and American Philosophical Society.

Further Resources

Massachusetts Institute of Technology. Faculty website. <http://web.mit.edu/aeroastro/www/people/widnall/>.

Wilhelmi, Jane Anne Russell

1911–1967

Endocrinologist

Education: B.A., University of California, Berkeley, 1932, Ph.D., biochemistry, 1937

Professional Experience: technical assistant in biochemistry, University of California, Berkeley, 1932–1933, assistant, institute of experimental biology, 1934–1937; research associate, pharmacology, Washington University, St. Louis, 1936; National Research Council (NRC) Fellow, School of Medicine, Yale University, 1938–1939, fellow, 1939–1941, instructor, physiological chemistry, 1941–1950; assistant professor, biochemistry, Emory University, 1950–1953, associate professor, 1953–1965, professor, 1965–1967

Jane Russell Wilhelmi was an endocrinologist whose research interests included endocrine control of intermediate metabolism; adrenal cortex, anterior pituitary, growth hormone, and insulin in carbohydrate and protein metabolism; the metabolic aspects of shock; and the use of isotopic tracers in metabolism. After receiving her undergraduate degree at the University of California, Berkeley, she worked as a technical assistant while she completed her doctorate in biochemistry in 1937. She spent a year in 1936 as a pharmacology research associate working on carbohydrate metabolism with Carl and **Gerty Cori** at Washington University in St. Louis. She was appointed a research fellow at Yale School of Medicine in 1938, a fellow in 1939, and an instructor in physiological chemistry in 1941. In 1940, she married her colleague, Alfred Ellis Wilhelmi, with whom she collaborated on research and co-authored dozens of scientific papers on metabolism and the role of growth hormones in breaking down proteins.

Jane Wilhelmi received outside recognition for her pioneering research, and consulted on committees of the National Institutes of Health, NRC, National Science Foundation, and National Science Board. Her research was acknowledged and supported with a California Fellowship in Biochemistry, a Rosenberg Fellowship, and the American Physiological Society's Porter Fellowship. Despite these honors, she did not advance at Yale, remaining at the rank of instructor before accepting a position as assistant professor of biochemistry at Emory University in Atlanta, Georgia, in 1950. She finally reached the rank of full professor in 1965, just two years before her death. Up until the time of her death, she remained active in research, writing, and working as an editor for the *American Journal of Physiology*. She received the Ciba

Award in 1946, and she shared the Upjohn Award of the Endocrine Society with her husband in 1961. She was also named Atlanta's Woman of the Year in 1961.

Williams, Anna Wessels

1863 1954

Bacteriologist

Education: diploma, New Jersey State Normal School, Trenton, 1883; M.D., Women's Medical College, New York, 1891

Professional Experience: public school teacher, 1883–1885; instructor, pathology, Women's Medical College of the New York Infirmary, 1891–1893, assistant to department chair, pathology and hygiene, 1891–1895; assistant bacteriologist, diagnostic laboratory, New York City Department of Health, 1895–1905, assistant director, 1905–1934

Concurrent Positions: consulting pathologist, Women's Medical College of the New York Infirmary, 1902–1905

Anna Williams was a pioneering bacteriologist who gained national recognition for her work on infectious diseases. At the diagnostic laboratory of the New York City Department of Health, she made significant contributions on effective immunization for diphtheria, streptococcal (strep throat) and pneumococcal (pneumonia) infections, scarlet fever, and rabies. In the first year of her research, she isolated a strain of the diphtheria bacillus that made possible the widespread immunization of children and almost complete eradication of the disease that, at that time, was one of the primary causes of death among young children. She played a significant role in building the New York laboratory into a nationally known center as the first municipal laboratory to apply bacteriology to the problems of public health. After receiving her diploma from the New Jersey State Normal School, she taught public school for several years to earn funds to obtain her M.D. in 1891 from the Women's Medical College of New York. She had convinced her family to allow her to become a physician after a sister almost died due to complications of childbirth.

After working as a pathologist for the Women's Medical College for several years, she was initially a volunteer with the diagnostic laboratory before joining the staff of the New York City Department of Health in 1895. She spent a year at the Pasteur Institute in Paris, unsuccessfully researching an antitoxin for scarlet

fever, but her work did lead to the development of a rabies vaccine by 1898 and a new, faster method for identifying rabies in animals. She later served as chair of a new rabies committee for the American Public Health Association and, during World War I, worked on government programs related to diagnosing influenza and meningitis. She was appointed assistant director of the diagnostic laboratory of the New York Department of Health in 1905, a position she held until forced into mandatory retirement in 1934 at the age of 71.

Williams was co-author of a book for the general public entitled *Who's Who among the Microbes* (1929). In addition to her scientific papers, she was also co-author of *Pathogenic Microorganisms Including Bacteria and Protozoa: A Practical Manual for Students, Physicians and Health Officers* (1905) and author of *Streptococci in Relation to Man in Health and Disease* (1932). She was a member of the American Public Health Association and the New York Women's Medical Association (president, 1915).

Further Resources

National Institutes of Health. "Dr. Anna Wessels Williams." Changing the Face of Medicine: Celebrating America's Women Physicians. National Library of Medicine, National Institutes of Health. http://www.nlm.nih.gov/changingthefaceofmedicine/physicians/biography_331.html.

Williams, Roberta

b. 1952

Computer Games Designer

Education: high school

Professional Experience: part-time programmer; designer of computer action games, 1979–1980; co-founder and chief game designer, Sierra On-Line, Inc., 1980–1999

Roberta Williams is considered a pioneer of the graphic adventure multimedia computer game. Williams did not attend college, but had some technical training and experience with mainframe computers in the 1970s. She became intrigued by text-based video games after purchasing an Apple computer. Her career started when her husband, programmer Kenneth Williams, brought home a computer game that she found was too easy to solve, so she was challenged to create more difficult games. The couple founded their own company, On-Line Systems (later known as Sierra On-Line) in 1980. Their first game, "Mystery House," debuted



Roberta Williams poses with a copy of her computer game, *Phantasmagoria*, 1995. (AP/Wide World Photos)

in 1980 and became part of a six-part series of Apple games that included the first bestselling games with colored graphics. Their second game, “The Wizard and the Princess,” was programmed on a disk rather than on a cassette, a format that revolutionized the microcomputer game industry by making possible much longer games. They also designed a computer game based on the Jim Henson movie *The Dark Crystal*, released at the same time, in 1992. Roberta also advised on some of the layouts for the movie. She was one of the first designers to use a female protagonist in an adventure game. She has also designed a range of other computer software products for home use.

By 1983, Sierra On-Line was earning \$10 million a year in sales, and by 1991, annual sales were

\$43 million and the company employed some 500 people. When the Williamses sold the company to CUC International, Inc. in 1996 for about \$1 billion, Roberta stayed on briefly as chief designer. In 1997, Sierra On-Line, Inc. released the “Roberta Williams Anthology,” a collection of 15 of her games. Most of the early ones are primitive by today’s standards, but the anthology is a compact history of the form. She began all of her games by drawing them out on large sheets of paper, but the later games eventually involved the work of more than 100 people, including animators, programmers, musicians, and composers. Williams has won numerous awards and honors for her games. She retired from Sierra On-Line in 1999 to travel with Ken, and the couple maintain a website and message boards for gaming enthusiasts.

Further Resources

MobyGames. “Roberta Williams: Developer Bio.” <http://www.mobygames.com/developer/sheet/view/developerId,60/>.

Sierra Gamers. <http://www.sierragamers.com>.

Witkin, Evelyn Maisel

b. 1921

Geneticist

Education: B.A., zoology, New York University, 1941; M.A., Columbia University, 1943, Ph.D., zoology, 1947

Professional Experience: research associate, bacterial genetics, Cold Spring Harbor Laboratories, Carnegie Institution, 1945–1955; associate professor, medicine, Downstate Medical Center, State University of New York, 1955–1969, professor, 1969–1971; professor, biology, Douglass College (Rutgers University), 1971–1983, Barbara McClintock Professor of Genetics, Rutgers, 1979, professor, Waksman Institute of Microbiology, 1983–1991, emerita

Concurrent Positions: postdoctoral fellow, American Cancer Society, 1947–1949

Evelyn Witkin is a geneticist who has been recognized for her work on mutation in bacteria. Her research has involved mechanism of spontaneous and induced mutation in bacteria, genetic effects of radiation, and enzymatic repair of DNA damage. While completing her doctorate in zoology from Columbia University, she spent a summer as a research associate in bacterial genetics at Cold Spring Harbor Laboratories where she first isolated a radiation-resistant strain of *E. coli*. She became a regular staff member at Cold Spring Harbor in 1945 and remained there for 10 years. She was appointed an associate professor of medicine at the State University of New York in 1955 and promoted to full professor in 1969. She moved to Douglass College, the women's campus at Rutgers University in New Jersey, in 1971 and joined the Waksman Institute of Microbiology at Rutgers in 1983. In the early 1970s, she made a breakthrough discovery on bacterial response to genetic damage and repair. She retired in 1991 as the Barbara McClintock Professor Emerita of Genetics.

Witkin was elected a member of the National Academy of Sciences in 1977 and awarded a National Medal of Science by President George W. Bush in 2003. She is also the recipient of honorary doctorates from New York Medical College (1978), Rutgers University (1995), and Clark University (2006). Among her other honors are the Lindback Award (1979), the American Women of Science Award for Outstanding Research (1982), the Thomas Hunt Morgan Medal of the Genetics Society of America (2000), and the Distinguished Research Award of the New Jersey Association for Biomedical Research (2004). She is a fellow of the American Academy of Arts and Sciences and American Society of Microbiology, and a member of the Genetics Society of America, American Society of Naturalists, and Radiation Research Society.

Further Resources

Rutgers University, Office of Media Relations. “President Bush Names Rutgers’ Evelyn Witkin for Nation’s Highest Science Honor.” (22 October 2003). <http://ur.rutgers.edu/medrel/viewArticle.html?ArticleID=3545>.

Wood, Elizabeth Armstrong

1912–2006

Crystallographer

Education: B.A., Barnard College, 1933; M.A., Bryn Mawr College, 1934, Ph.D., geology, 1939

Professional Experience: instructor, geology, Bryn Mawr College, 1934–1935, 1937–1938; assistant, Barnard College, 1935–1937, lecturer, geology and mineralogy, 1938–1941; research assistant, Columbia University, 1941–1942; technical staff, crystal research, Bell Telephone Laboratories, AT&T, 1942–1967

Elizabeth Wood was recognized for her research on x-ray crystallography and the physical properties of crystals. She also studied the geology and petrology of igneous and metamorphic rocks, and optical mineralogy. Wood received her undergraduate degree from Barnard in 1933. After earning her master’s degree at Bryn Mawr in 1934, she was employed there as a demonstrator in geology while she did further graduate work. In 1938, she returned to Barnard as a lecturer, and in 1939, she received her doctorate in geology from Bryn Mawr. She was promoted to research assistant at Barnard in 1941 before joining the technical staff in crystallographic research at Bell Telephone Labs in 1942—the first woman scientist in the physical research department. Her career coincided with the beginning of the discipline of solid-state physics, and Bell Labs was one of the first developers of lasers and other solid-state devices that required crystals. Wood became an acknowledged authority at Bell and was even called upon to receive the first call on a “picture-phone,” made from First Lady Johnson from the White House to Wood in New York in 1964. She spent 25 years at Bell/AT&T, retiring in 1967.

Wood was also committed to science education and published several textbooks and guides, including *Rewarding Careers for Women in Physics* (1962) and *Pressing Needs in School Sciences* (1969), both published by the American Institute of Physics, and *Crystal Orientation Manual* (1963) and *Crystals and Light: An Introduction to Optical Crystallography* (1964), which remain classics in the field. In

the 1960s, she also published (through Bell Labs) a high school curriculum, *Experiments with Crystals and Light*, and a general-interest book, *Science for the Airplane Passenger*, which was sold through airport bookstores. The American Crystallographic Association (ACA) established the Elizabeth A. Wood Science Writing Award in her honor.

Wood was active in professional scientific organizations, serving as secretary of the American Society for X-Ray and Electron Diffraction (ASXRED) in 1947, and was the first female president of the American Crystallographic Association in 1957 (**Isabella Karle** became the second, in 1976). She received honorary doctorates from Wheaton College (1963), Western College, Ohio (1965), and Worcester Polytechnic (1970). She was a fellow of the American Academy of Arts and Sciences, American Physical Society, International Union of Crystallography, and Mineralogical Society of America.

Further Resources

Abrahams, S. C. "Death Notice. Elizabeth A. Wood. 19 October 1912–23 March 2006." *Physics Today*. (12 May 2006). http://www.physicstoday.org/obits/notice_060.shtml.

Woods, Geraldine (Pittman)

1921–1999

Embryologist, Science Consultant

Education: B.S., biology, Howard University, 1942; M.A., Radcliffe College, 1943, Ph.D., neuroembryology, 1945

Professional Experience: instructor, biology, Howard University, 1945–1946; special consultant, National Institute of General Medical Sciences, National Institutes of Health (NIH), 1969–1987

Geraldine Woods was an embryologist who was primarily known for her efforts to improve access to higher education for minorities. In addition to her volunteer work, she served as a consultant to the National Institute of General Medical Sciences in implementing various programs. She was one of the earliest black women to hold a Ph.D. in the biological sciences, and her doctoral research involved the early development of nerves in the spinal cord, studying whether the nerve specialization process was governed by the cell's heredity or by stimulation from nearby cells. While attending Talladega College in Alabama, her mother became seriously ill. The physicians recommended she take treatments at Johns Hopkins University, so Geraldine transferred to nearby Howard University in Washington,

D.C. An embryology professor at Howard encouraged her to continue her studies at Harvard University. At that time, the women enrolled in Radcliffe College took all of their science classes at Harvard, and she earned two graduate degrees in three years.

After receiving her doctorate, Woods taught biology at Howard before moving to California, where her husband set up his dental practice. She raised three children and began volunteering with social services projects and civil rights efforts, first locally, in Los Angeles, and then statewide. She served four years (1963–1967) as president of Delta Sigma Theta, a national public-service sorority of black, college-educated women. It was through this group that she helped establish several Head Start preschools in the Los Angeles area. Her work attracted national attention when Lady Bird Johnson, wife of President Lyndon Johnson, invited her to the White House in 1965 to help launch Project Head Start, a federal program to help children from low-income families attend preschool. In 1968, President Johnson appointed her chair of the Defense Advisory Committee on Women in the Services.

In 1969, Woods was appointed as a special consultant to the National Institute of General Medical Sciences of the NIH, where she addressed problems of minority students and institutions gaining access to grants and other funding, their overall lack of adequate equipment for scientific research, and educational opportunities for minority students in the sciences. The NIH installed two programs under her guidance: the Minority Biomedical Support (MBS) program to guide researchers through the grant application process, and Minority Access to Research Careers (MARC), which provided counseling and scholarships for students and faculty members in science careers.

Woods was a member of the American Association for the Advancement of Science and the New York Academy of Sciences. Among her awards and honors are several biomedical scholarships given in her name, and the Mary Church Terrell Award of Delta Sigma Theta (1979), the Scroll of Merit of the National Medical Association (1979), the Howard University Achievement Award (1980), and a Distinguished Leadership Achievement Award from the National Association for Equal Opportunity in Higher Education (1987). She received honorary degrees from several institutions, including Benedict College (1977), Talladega College (1980), Fisk University (1991), Bennett College (1993), Meharry Medical College (1988), and Howard University (1989).

Further Resources

Giddings, Paula A. 1994. *In Search of Sisterhood: Delta Sigma Theta and the Challenge of the Black Sorority Movement*, 2nd ed. New York: William Morrow.

Warren, Wini. 1999. *Black Women Scientists in the United States*. Bloomington: Indiana University Press.

Woolley, Helen Bradford Thompson

1874 1947

Psychologist

Education: B.A., University of Chicago, 1897, Ph.D., neurology, 1900

Professional Experience: instructor and professor, psychology, Mount Holyoke College, 1901–1905; experimental psychologist, Bureau of Education, Philippine Islands, 1905–1906; health inspector, serum laboratory, Bangkok, Thailand, 1907–1908; instructor, philosophy, University of Cincinnati, 1910–1912; director, Bureau for the Investigation of Working Children, Cincinnati public schools, 1911–1921; psychologist and assistant director, Merrill-Palmer School, Michigan, 1921–1926; professor of education and director, bureau of child development, Teachers College, Columbia University, 1926–1930

Helen Woolley was a pioneer in the study of child development and of gender differences. Her research involved the psychology of adolescence and of young childhood, mental development, testing, and educational methods, and exposing what she termed the “inconsistencies, contradictions, and lack of data behind the conventional wisdom on sex differences.” Woolley (then Thompson) challenged beliefs about women’s “natural” roles and interests, and used scientific data to support women’s participation in academia and the workplace. For her doctoral research at the University of Chicago, she created a series of tests of male and female students’ physical and mental processes. In her thesis, *Psychological Norms in Men and Women* (published in 1903 as *The Mental Traits of Sex*), she concluded that there were few biological or psychological differences between men and women, and that social and environmental factors accounted for most differences. Not surprisingly, Woolley became an advocate of both civil rights and women’s rights, becoming a member and chair of the Ohio Woman Suffrage Association.

After she received her doctorate from the University of Chicago in 1900, she undertook further studies at the Universities of Berlin and Paris before she accepted a position in the psychology department at Mount Holyoke in 1901. When she was married in 1905, she and her husband spent several years in Southeast Asia, where she worked in the Philippine Bureau of Education and at

a laboratory run by her physician husband in Thailand. The couple returned to the United States, where she taught at the University of Cincinnati for three years and became involved in child welfare reforms and child psychology. After Ohio passed a child labor law in 1910, she served as director of a program to compare the development of working children with those who stayed in school, and her work contributed to educational reforms, such as compulsory attendance laws. She accepted a position as assistant director and psychologist at the Merrill-Palmer School, a child development institute in Detroit, in 1921, and she helped develop a teacher-training program and design educational tests, such as the Merrill-Palmer Scale of Mental Tests. In 1926, Woolley took a position at Teachers College, Columbia University, as professor of education and director of the bureau of child development. She was forced to retire in 1930 due to health issues.

Woolley contributed a chapter on “The Psychologist” for a 1920 guide to *Careers for Women* (edited by Catherine Filene). She was elected president of the National Vocational Guidance Association in 1921. She also was a member of the American Psychological Association and the American Association for the Advancement of Science.

Further Resources

Morse, Jane Fowler. 2002. “Ignored but Not Forgotten: The Work of Helen Thompson Bradford Woolley.” *NWSA Journal*. 14(2): 121–147. (Summer 2002).

Scarborough, Elizabeth and Laurel Furumoto. 1987. *Untold Lives: The First Generation of American Women Psychologists*. New York: Columbia University Press.

Wright, Margaret H.

b. 1944

Computer Scientist, Mathematician

Education: B.S., mathematics, Stanford University, M.S., computer science, Ph.D., computer science, 1976

Professional Experience: research associate, Systems Optimization Laboratory, Operations Research, Stanford University, 1976–1981, senior research associate, 1981–1988; technical staff, Bell Laboratories, AT&T, 1988–1993, Distinguished Member of Technical Staff, 1993–2001, head, Scientific Computing Research Department, 1997–2000; Silver Professor of Computer Science and

Chair, Department of Computer Science, Courant Institute of Mathematical Sciences, New York University, 2001–

Margaret Wright is a computer scientist and applied mathematician whose research interests include optimization, linear algebra, numerical analysis, scientific computing, and scientific and engineering applications. She builds mathematical and computer models for problem solving in a variety of practical applications. She earned degrees from Stanford University and spent more than 20 years in Scientific Computing Research at AT&T's Bell Laboratories (now Lucent Technologies) before entering academia in 2001 as professor and chair of computer sciences at the Courant Institute of Mathematical Sciences at New York University. She has co-authored two books on optimization and has published dozens of scientific papers, articles, and technical reports.

Wright was elected to the National Academy of Engineering in 1997 and the National Academy of Sciences in 2005. She has been a distinguished lecturer and committee member for numerous academic and government scientific organizations, including the National Science Foundation, National Research Council, and U.S. Department of Energy. She has received an honorary doctorate from the University of Waterloo (2003) and was the Emmy Noether Lecturer of the Association for Women in Mathematics (2000). Her other awards and honors include a Special Award for Distinguished Service to the Profession from the Society for Industrial and Applied Mathematics (SIAM) (2000) and an Award for Distinguished Public Service from the American Mathematical Society (2001). She served as president of SIAM in 1995–1996. She is a fellow of the Institute for Operations Research and the Management Sciences and of the American Academy of Arts and Sciences, and a member of the Mathematical Programming Society.

Further Resources

Agnes Scott College. "Margaret Wright." Biographies of Women Mathematicians. <http://www.agnesscott.edu/lriddle/women/wright.htm>.

New York University. Faculty website. <http://cs.nyu.edu/mhw/>.

Wrinch, Dorothy Maud

1894–1976

Biochemist, Mathematician

Education: mathematics and philosophy, Girton College, Cambridge; M.Sc., University of London, 1920, D.Sc., 1922; M.A., Oxford University, 1924, D.Sc., 1929



Biochemist and mathematician, Dorothy Maud Wrinch, right, shows physicist Katharine Blodgett of General Electric her protein molecule model, 1938. (AP/Wide World Photos)

Professional Experience: lecturer, pure mathematics, University College, University of London, 1918–1920; lecturer, mathematics and director, studies for women, member, faculty of physical sciences, Oxford University, 1923–1939; research fellow, Somerville College, Oxford, 1939–1941; lecturer, chemistry, Johns Hopkins University, 1939–1941; visiting professor, natural sciences, Amherst College and Mount Holyoke College, 1941–1942; lecturer, physics, Smith College, 1941–1954, visiting professor, 1954–1971

Dorothy Wrinch was a biochemist and mathematician whose interests spanned mathematical physics, molecular biology, chemistry, genetics, the philosophy of science, and sociology. In 1929, she was the first woman to receive a doctorate in science from Oxford University. In the mid-1930s, she developed an important contribution to science—the first theory of protein structure, or the “cyclol theory” of amino acids holding the keys to the genetic code. She received a Rockefeller Foundation grant for this groundbreaking work applying mathematics to molecular biology, but her funding and her reputation were damaged when prominent scientists, notably Linus Pauling, publicly rejected her theory. Although her theory

was proven incorrect (as was Pauling's early theory), it later applied to other aspects of chemical bonds in alkaloids and thus contributed to scientific advances. Her argument with Pauling began in the late 1930s, but she published her research in two books, *Chemical Aspects of the Structure of Small Peptides: An Introduction* (1960) and *Chemical Aspects of Polypeptide Chain Structure: An Introduction* (1960). Wrinch held a wide range of scientific interests and engaged in collaborative work with other scientists on topics related to theoretical physics and philosophy, and published nearly 200 articles and papers.

In addition to the degree from Oxford, Wrinch also received a doctorate from the University of London and spent many years at a student at Cambridge and at the Universities of Vienna and Paris. She alternated between teaching at London and Oxford before coming to the United States with her daughter after her marriage ended in 1938. Wrinch accepted a position as a lecturer in chemistry at Johns Hopkins and went on to hold lectureships and fellowships at Amherst, Mount Holyoke, and at Smith College, where she spent 30 years as a teacher but never secured a permanent faculty appointment.

Wrinch was elected a fellow of the American Physical Society and the London Royal Society, and was a member of the American Chemical Society and the American Crystallographic Association. In 1930, she published a book, *The Retreat from Parenthood*, under a pseudonym (Jean Ayling), in which she addressed the choice many educated women had to make between careers and family life, and advocated for greater childcare services.

Further Resources

Abir-Am, Pnina G. and Dorinda Outram. 1987. *Uneasy Careers and Intimate Lives: Women in Science, 1789–1979*. New Brunswick, NJ: Rutgers University Press.

Agnes Scott College. "Dorothy Maud Wrinch." Biographies of Women Mathematicians. <http://www.agnesscott.edu/lriddle/women/wrinch.htm>.

Wu, Chien-Shiung

1912–1997

Nuclear Physicist

Education: B.S., physics, National Central University, China, 1934; Ph.D., physics, University of California, Berkeley, 1940

Professional Experience: lecturer, University of California, Berkeley, 1940–1942; assistant professor, Smith College, 1942–1943; instructor, Princeton University,



Physicist Chien-Shiung Wu with a particle accelerator at Columbia University, 1963.
(Robert W. Kelley/Time Life Pictures/Getty Images)

1943–1944; senior scientist, Columbia University, 1944–1947, associate, 1947–1952, associate professor to professor, physics, 1952–1972, professor, physics, 1972–1981

Concurrent Positions: member, advisory committee to director, National Institutes of Health (NIH), 1975–1982

Chien-Shiung Wu was one of the top women in elementary particle physics in the world in the mid-twentieth century, and her work contributed to the research that earned two of her Columbia University colleagues, Drs. Tsung Dao Lee and Ning Yang, the Nobel Prize in Physics in 1957. She researched the separation of uranium isotopes and experimentally established nonconservation of parity in beta decay and conservation of vector current in beta decay. At the time she received her doctorate from Berkeley, in 1940, not one of the nation's top research universities had a female physics professor. She was hired as an instructor at Princeton due to the shortage of male scientists during World War II. In 1944, she was

appointed a senior scientist at Columbia, where she helped develop sensitive radiation detectors for the atomic bomb project. After the war ended and the Manhattan Project was completed, she was asked to remain at Columbia, where she spent the remainder of her career as a physics professor. Wu's research focused on radiation detection equipment and, as she moved through the faculty ranks, she conducted experiments to test the theories of Lee and Yang. The two scientists who shared the Nobel Prize acknowledged Wu's role in the success of proving their theory; Lee later said of Wu that she "was one of the giants of physics."

Born in Shanghai, Wu was the daughter of an elementary school principal who founded a women's vocational school and impressed upon her the importance of education. She studied English and science in high school and graduated with a physics degree from the National Central University in Nanking. She did graduate-level study and worked as a research assistant at Zhejiang University and at the Institute of Physics of the Academia Sinica but, wishing to take her education further, Wu moved to the United States to study at the University of California, Berkeley, where she worked with professor Ernest Lawrence, who won the Nobel Prize in Physics in 1939, while Wu was a student there. She worked as Lawrence's research assistant and, after receiving her Ph.D. in 1940, continued as a lecturer at Berkeley, then taught at Smith College and Princeton before moving to Columbia in New York.

Wu was elected a member of the National Academy of Sciences in 1958. She received honorary degrees from several universities, including Princeton, where, also in 1958, she was the first woman to receive an honorary doctorate in science. She was the recipient of numerous awards, both in China and in the United States, including an Achievement Award for the American Association of University Women (1960), the Comstock Award of the National Academy of Sciences (1964), an Achievement Award from the Chi-Tsin Culture Foundation of Taiwan (1965), the Scientist of the Year Award from *Industrial Research Magazine* (1974), the Bonner Prize of the American Physical Society (1975), the National Medal of Science (1975), and the Wolf Prize in Physics in Israel (1978). She was the first living scientist with an asteroid named after her (1990). She was a fellow of the American Association for the Advancement of Science, an honorary fellow of the Royal Society of Edinburgh, and a member of the American Physical Society (president, 1975), the American Academy of Arts and Sciences, and Academia Sinica, the Academy of Sciences in China.

Further Resources

McGrayne, Sharon Bertsch. 1993. *Nobel Prize Women in Science: Their Lives, Struggles, and Momentous Discoveries*. Secaucus, NJ: Carol Pub. Group.

Byers, Nina and Gary A. Williams. 2006. *Out of the Shadows: Contributions of Twentieth-Century Women to Physics*. New York: Cambridge University Press, 2006.

Wu, Ying-Chu (Lin) Susan

b. 1932

Aerospace Engineer

Education: B.S., mechanical engineering, National Taiwan University, 1955; M.S., aerospace engineering, Ohio State University, 1959; Ph.D., aeronautics, California Institute of Technology, 1963

Professional Experience: engineer, Taiwan Highway Bureau, 1955–1956; senior engineer, Electro-Optical Systems, 1963–1965; assistant professor, University of Tennessee, 1965–1967, associate professor, 1967–1973, professor, aerospace engineering, University of Tennessee Space Institute (UTSI), 1973–1988; president and chief executive officer, Engineering Research Consulting, Inc., 1988–

Concurrent Positions: laboratory manager, research and development laboratory, University of Tennessee, 1977–1981, administrator, Energy Conversion Research and Development Program, University of Tennessee, 1981–1988

Susan Wu is an aerospace engineer renowned for her research on the potential for cleaner and more efficient methods of coal-fired power generation in the United States through the use of magnetohydrodynamics (MHD), which produce electric power without the use of rotating machinery by passing a plasma through a magnetic field. This method of power generation is cleaner and more efficient than the traditional power plant, and MHD generation is also used as a power source for aircraft. Wu's field of research is an important one primarily because of increasing mandates from the federal government to reduce emissions from coal-fired power plants and to reduce the use of fossil fuels, such as coal, to preserve them for future generations. After a productive career as an engineer and then aerospace engineering professor, Wu founded her own company in 1988, Engineering Research Consulting, Inc. Wu still serves as the company chairman, and her oldest son, Dr. Ernie Wu, is the president and chief executive officer.

After she received her undergraduate degree in 1955, Wu found that engineering jobs for women were scarce in China. She moved to the United States, where she received graduate degrees in aerospace engineering and aeronautics. She became a professor at the University of Tennessee Space Institute (UTSI), but left academia after 23 years to found her own aerospace and energy research consulting firm, ERC, Inc., now headquartered in Huntsville, Alabama. ERC consults for such agencies as the National Aeronautics and Space Administration, the Department of Energy, and the Argonne National Laboratory, and for corporations such as Boeing and McDonnell Douglas.

Wu has been a member of the advisory board of the National Air and Space Museum of the Smithsonian Institution since 1993 and has received several awards, including the University of Tennessee's Chancellor's Research Scholar Award (1978), Outstanding Educators of America Award (1973 and 1975), Society of Women Engineers Achievement Award (1985), and Plasmadynamics and Lasers Award of the American Institute of Aeronautics and Astronautics (1994). She is a three-time recipient of the Amelia Earhart Fellowship (1958, 1959, 1962) from the women's advocacy organization, Zonta International, for women in aerospace science and engineering. She is a fellow of the American Institute of Aeronautics and Astronautics and the American Society of Mechanical Engineers, and a member of the Society of Women Engineers.

Further Resources

ERC Incorporated. <http://erc-incorporated.com/comphistory.aspx>.



Yalow, Rosalyn Sussman

b. 1921

Medical Physicist

Education: A.B., Hunter College, 1941; M.S., University of Illinois, 1942, Ph.D., physics, 1945

Professional Experience: assistant, physics, University of Illinois, 1941–1943, instructor, 1944; assistant engineer, Federal Telecommunications Laboratory, 1945–1946; lecturer and assistant professor, physics, Hunter College, 1946–1950; physicist, assistant chief, chief, radioimmunoassay service, Veterans Administration (VA) Hospital, Bronx, New York, 1950–1970, nuclear medical service, 1970–1980; chair, clinical science, Montefiore Hospital and Medical Center, 1980–1985

Concurrent Positions: consultant, radioisotope unit, Veterans Administration Hospital, 1947–1950; research professor, Mount Sinai School of Medicine, 1968–1974, distinguished service professor, 1974–1979; distinguished professor at large, Albert Einstein College of Medicine, Yeshiva University, 1980–1985; Solomon A. Berson distinguished professor at large, Mount Sinai School of Medicine, 1986–

Rosalyn Yalow was a co-recipient of the Nobel Prize in Physiology or Medicine in 1977, the second woman to win in that category (**Gerty Cori** had been the first, in 1947). She and her collaborators were pioneers in the new science of neuroendocrinology, a discipline that enables doctors to diagnose conditions caused by hormonal changes. Yalow's work combined immunology, isotope research, mathematics, and physics, and established the field of modern biomedical physics. She set up one of the first radioisotope labs in the United States when she was hired in 1947 at the VA Hospital in the Bronx. The initial plan was that radioisotopes would be a cheap alternative to radium for cancer treatment. With her engineering experience, she was able to design her own equipment, as no commercial instrumentation existed at the time.

As a graduate student in physics at the University of Illinois, Yalow was assigned to teach only pre-med students, as no female faculty taught male engineering and science students. This changed, however, as more men were called to war and women were called to fill teaching positions. After completing her Ph.D., she became the first woman engineer at the Federal Telecommunications



Physicist Rosalyn Yalow was co-recipient of the 1977 Nobel Prize in Physiology or Medicine for her development of the radioimmunoassay (RIA) technique. (National Library of Medicine)

Laboratory for a year before returning to her alma mater, Hunter College, to teach. In 1947, she began her long tenure with the VA Hospital and a fruitful collaboration with physician Solomon Berson. Together, they invented radioimmunoassay (RIA), or the method of using radioactively tagged substances to measure antibodies produced by the immune system. By accident, they discovered that the insulin obtained from animal sources had minor but important differences from human insulin, namely that human insulin contains antibodies created by the immune system. The result of their research was that manufactured insulin could be genetically engineered to be precisely the same as human insulin. She and Berson did not patent their discovery, and commercial laboratories have realized enormous profits from performing RIA.

Yalow and Berson published numerous papers together, always alternating first authorship, and earned numerous awards for their work. Although Berson accepted a position at Mount Sinai School of Medicine in 1968, they continued their work together until he died in 1972. It was already rumored at that time that the two were candidates for a shared Nobel Prize, but Berson's premature death

in 1972 removed his name from consideration, as the prize is not awarded posthumously. Yalow continued her research and was finally recognized with the Nobel Prize in Physiology or Medicine in 1977. She went on to teach at Mount Sinai, at Montefiore Hospital and Medical Center, and at Albert Einstein College of Medicine. She helped establish and direct the Solomon A. Berson Research Laboratory at the Bronx VA Hospital and held the Berson Distinguished Professorship at Mount Sinai School of Medicine. She retired from full-time research in the 1980s, but retained positions as affiliated faculty at several schools and continued to use her office at the VA Hospital until 2002.

Yalow was elected to the National Academy of Sciences in 1975. She was the first woman and first nuclear physicist to win the Albert Lasker Medical Research Award (1976), and is also the recipient of a National Medal of Science (1988). She was elected president of the Endocrine Society (1978–1979) and fellow of the New York Academy of Sciences. She has been a member of the American Academy of Arts and Sciences, the Radiation Research Society, the American College of Radiology, the Biophysical Society, the American Diabetes Association, and the American Physiological Society.

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- McGrayne, Sharon Bertsch. 1998. *Nobel Prize Women in Science: Their Lives, Struggles, and Momentous Discoveries*. Secaucus, NJ: Birch Lane Press.
- Straus, Eugene. 1998. *Rosalyn Yalow, Nobel Laureate: Her Life and Work in Medicine*. New York: Basic Books.

Young, Anne Sewell

1871–1961

Astronomer

Education: B.L., Carleton College, 1892, M.S., 1897; University of Chicago, 1898, 1902; Ph.D., astronomy, Columbia University, 1906

Professional Experience: instructor, mathematics, Whitman College, 1892–1893, professor, 1893–1895; high school principal, 1897–1899; instructor to professor, astronomy, and director, John Payne Williston Observatory, Mount Holyoke College, 1899–1936

Anne Young was an astronomer recognized for her research on observations of variable stars, measurement of astronomical photographs, and reduction of

occultation observations. She conducted an active program at Mount Holyoke on sunspot observations, asteroid positions, comet orbits, and variable stars. Young had an early interest in astronomy, and her uncle, Charles Young, was a renowned professor of astronomy at Princeton University. After receiving her undergraduate degree from Carleton College in 1892, she was an instructor and then professor of mathematics at Whitman College for four years. She returned to Carleton for her master's degree and was a high school principal for a year. She took additional studies at the University of Chicago before receiving her doctorate in astronomy from Columbia in 1906. Her doctoral research was based on the photographic measurements of stars within the constellation of Perseus.

Young was appointed an instructor at Mount Holyoke in 1899 and rose through the ranks to professor, retiring in 1936. Throughout her tenure at Mount Holyoke, she was also director of the Williston Observatory. She published numerous papers in astronomical journals, and in 1900, she started a program of daily sunspot observations at Mount Holyoke that led to a worldwide cooperative research project. One of her contributions to the profession was that she promoted popular interest in astronomy by writing a monthly column on astronomy for a local paper, the *Springfield Republican*, and by providing a series of open nights at the observatory for the public. She was beloved as a teacher and, in 1925, took an entire class of students from Mount Holyoke in Massachusetts to Connecticut by train to see the total eclipse of the sun that year.

Young was elected a fellow of the American Astronomical Society, the Royal Astronomical Society, and the American Association for the Advancement of Science, and was elected president of the American Association of Variable Star Observers (1923).

Young, Roger Arliner

1899 1964

Zoologist

Education: B.S., Howard University, 1923; M.S., University of Chicago, 1926; Ph.D., zoology, University of Pennsylvania, 1940

Professional Experience: instructor and interim department head, zoology, Howard University, Washington, D.C., 1923–1936; researcher, Marine Biological Laboratory, Woods Hole, Massachusetts; assistant professor, biology, North Carolina College for Negroes; instructor, biology, Shaw University, Raleigh, North Carolina; instructor, Jackson State College, Mississippi; instructor, Paul Quinn College, Texas; lecturer, biology, Southern University, Louisiana

Roger Arliner Young was a zoologist and marine biologist who was the first African American woman to receive a doctorate in zoology. Her research focused on the effects of radiation and ultraviolet light on sea urchin eggs, and hydration and salt concentration in other organisms. She published an article in *Science*, “On the Excretory Apparatus in Paramecium,” before even receiving her master’s degree. She published several other scientific papers in the 1930s.

Young enrolled at Howard University in Washington, D.C., in 1916. Her family was poor, and she was responsible for the care of her invalid mother, causing her grades in school to suffer. For these reasons, it took seven years for Young to earn her bachelor’s degree from Howard. She originally intended to study music, but took her first science course in 1921 with biology and zoology professor Ernest Everett Just, who became an important mentor for Young and encouraged her to pursue graduate work in the sciences. After receiving her degree from Howard in 1923, she went on to attend the University of Chicago part-time. She received her master’s degree in 1926 and was invited by Just to work with him at the Woods Hole Marine Biological Laboratory in Massachusetts during the summers. Young began her work on marine embryology, fertilization, and the processes of hydration and dehydration. Just asked her to stand in for him as head of the zoology department at Howard on several occasions when he made trips to Europe to seek research funding.

Young returned to the University of Chicago in 1929 to pursue a doctorate with another professor she had met at Woods Hole. She did not pass her qualifying exams, however, and returned to teach at Howard for several more years. In 1936, she was fired by Everett Ernest Just for reasons that seemed to be both political (pressures from the dean) and personal (a rift with Just over rumors about the nature of their relationship). She left Howard and moved to the University of Pennsylvania to resume work toward a doctorate, which she finally received in 1940 with a dissertation on “The Indirect Effects of Roentgen Rays on Certain Marine Eggs.” After 1940, she taught at colleges in North Carolina, Mississippi, Louisiana, and Texas. She continued to care for her mother until her mother’s death in 1953 and lived on the brink of poverty, unable to retain a teaching position very long. Her research using ultraviolet light had damaged her eyesight and, at one point, she was admitted to the Mississippi State Mental Asylum due to poor mental health. She died in New Orleans in 1964.

Further Resources

Manning, Kenneth R. 1983. *Black Apollo of Science: The Life of Ernest Everett Just*. New York: Oxford University Press.

Warren, Wini. 1999. *Black Women Scientists in the United States*. Bloomington: Indiana University Press.

Z

Zoback, Mary Lou

b. 1952

Geophysicist

Education: B.S. geophysics, Stanford University, 1974, M.S. 1975, Ph.D., 1978

Professional Experience: National Research Council postdoctoral fellow, Heat Flow Studies, U.S. Geological Survey (USGS), 1978–1979, research scientist, Earthquake Hazards Team, USGS, 1979–1999, chief scientist, Western Earthquake Hazards Team, 1999–2003, senior research scientist and program coordinator, Northern California Earthquake Hazards Program, 2003–2006; vice president, Earthquake Risk Applications, Risk Management Solutions (RMS), 2006–

Concurrent Positions: visiting scholar, Geophysical Institute, Karlsruhe, Germany, 1990–1991

Mary Lou Zoback is an internationally recognized geophysicist who specializes in plate tectonics and earthquakes. She has researched and mapped plate stresses, in particular focused on the San Andreas fault system which runs through California. She led the World Stress Map Project (1986–1992) of the International Lithosphere Program, a coalition of scientists from 30 countries who compiled geologic data on worldwide active tectonics and stress for environmental scientists and government risk assessments. Zoback earned three degrees in geophysics from Stanford University and has spent nearly 25 years at the USGS Office of Earthquake Studies. She left the USGS in 2006 to become vice president of Earthquake Risk Applications at RMS in Newark, California. At RMS, she provides scientific data for purposes of assessing earthquake risk, risk-reduction plans, insurance needs, and disaster management and response. In 2006, she helped found the 1906 Earthquake Centennial Alliance to commemorate the San Francisco Earthquake of 1906 and raise public awareness about earthquake safety. Zoback is also committed to science education and has been involved with Expanding Your Horizons, a national program to encourage young girls in science, math, and technology careers.

Zoback has served on numerous scientific and government committees, including for the National Science Foundation, National Research Council, National Aeronautics and Space Administration (NASA), and several universities. She was elected to

the National Academy of Sciences in 1995. She is a fellow of the Geological Society of America (GSA) (president, 1999–2000) and American Geophysical Union, and a member of the American Geological Institute, Seismological Society of America, and Earthquake Engineering Research Institute. She has received the Macelwane Award of the AGU (1987), the USGS Gilbert Fellowship Award for a visiting scholarship in Germany (1990–1991), Meritorious Service Award of the Department of Interior (2002), Bownocker Medal of Ohio State University (2003), Innovation and Exemplary Practice in Earthquake Risk Reduction Award from the Earthquake Engineering Research Institute (2006), and Arthur L. Day Medal (2007) and Public Service Award (2007) of the GSA.

Further Resources

National Academy of Sciences. 2003. “InterViews: Mary Lou Zoback, Geophysics.” http://www.nasonline.org/site/PageServer?pagename=INTERVIEWS_Mary_Lou_Zoback.

Women Nobel Prize Winners in the Sciences

Physics

- 1903 Marie Curie
- 1963 Maria Goeppert-Mayer

Chemistry

- 1911 Marie Curie
- 1935 Irène Joliot-Curie
- 1964 Dorothy Crowfoot Hodgkin
- 2009 Ada E. Yonath

Physiology or Medicine

- 1947 Gerty Cori
- 1977 Rosalyn Yalow
- 1983 Barbara McClintock
- 1986 Rita Levi-Montalcini
- 1988 Gertrude B. Elion
- 1995 Christiane Nüsslein-Volhard
- 2004 Linda B. Buck
- 2008 Françoise Barré-Sinoussi
- 2009 Elizabeth H. Blackburn
- 2009 Carol W. Greider

Economic Sciences

- 2009 Elinor Ostrom

Scientists by Discipline

Aerospace & Astronautics

Berger, Marsha J.
Brill, Yvonne (Claeys)
Cleave, Mary L.
Cobb, Geraldyn M.
Collins, Eileen
Cowings, Patricia Suzanne
Darden, Christine V. Mann
Dunbar, Bonnie J.
Fisher, Anna L.
Flugge Lotz, Irmgard
Hamilton, Margaret
Jemison, Mae Carol
Johnson, Barbara Crawford
Johnston, Mary Helen
Kurtzig, Sandra L. (Brody)
Leveson, Nancy G.

Long, Irene (Duhart)
Lucid, Shannon (Wells)
Ocampo, Adriana C.
Ochoa, Ellen
Resnik, Judith A.
Ride, Sally Kristen
Seddon, Margaret Rhea
Simon, Dorothy Martin
Stoll, Alice Mary
Sullivan, Kathryn D.
Thornton, Kathryn (Cordell)
Townsend, Marjorie Rhodes
Whitson, Peggy A.
Widnall, Sheila (Evans)
Wu, Ying-Chu (Lin) Susan

Animal Sciences

Altmann, Jeanne
Altmann, Margaret
Fossey, Dian
Grandin, Temple

Moss, Cynthia Jane
Poole, Joyce
Saif, Linda

Anthropology & Archaeology

Aberle, Sophie Bledsoe	Leacock, Eleanor (Burke)
Archambault, JoAllyn	Linares, Olga Frances
Bateson, Mary Catherine	Lubic, Ruth (Watson)
Beall, Cynthia	Lurie, Nancy (Oestreich)
Benedict, Ruth Fulton	Marcus, Joyce
Bricker, Victoria (Reifler)	Martin, Emily
Buikstra, Jane Ellen	Mead, Margaret
Cole, Johnnetta (Betsch)	Medicine, Beatrice A.
Colson, Elizabeth Florence	Parsons, Elsie Worthington Clews
De Laguna, Frederica Annis	Reichard, Gladys Amanda
Ellis, Florence May Hawley	Semple, Ellen Churchill
Haas, Mary Rosamond	Shipman, Pat
Harrison, Faye Venetia	Slye, Maud Caroline
Hawkes, Kristen	Sudarkasa, Niara
Helm, June	Thompson, Laura Maud
Hrdy, Sarah C. (Blaffer)	Watson, Patty Jo (Andersen)

Astronomy & Astrophysics

Bahcall, Neta	Lippincott, Sarah Lee
Burbidge, (Eleanor) Margaret	Makemson, Maud Worcester
Cannon, Annie Jump	Maury, Antonia Caetana de Paiva
Cordova, France Anne-Dominic	Pereira
Elmegreen, Debra Meloy	McFadden, Lucy-Ann Adams
Faber, Sandra (Moore)	Meinel, Marjorie Pettit
Furness, Caroline Ellen	Payne Gaposchkin, Celelia Helena
Geller, Margaret Joan	Prince, Helen Walter Dodson
Gill, Jocelyn Ruth	Prinz, Dianne Kasnic
Hammel, Heidi	Roemer, Elizabeth
Hoffleit, (Ellen) Dorrit	Roman, Nancy Grace
Intriligator, Devrie (Shapiro)	Rubin, Vera (Cooper)
Leavitt, Henrietta Swan	Shoemaker, Carolyn (Spellmann)

Sitterly, Charlotte Emma Moore
 Small, Meredith F.
 Smith, Elske (van Panhuys)

Tinsley, Beatrice Muriel (Hill)
 Young, Anne Sewell

Biochemistry

Banfield, Jillian F.
 Benesch, Ruth Erica (Leroi)
 Blackburn, Elizabeth
 Briscoe, Anne M.
 Brown, Barbara B.
 Brown, Rachel Fuller
 Chilton, Mary-Dell (Matchett)
 Cohn, Mildred
 Cori, Gerty Theresa Radnitz
 Daly, Marie Maynard
 Delmer, Deborah
 Edwards, Cecile Hoover
 Elion, Gertrude Belle
 Emerson, Gladys Anderson
 Fink, Kathryn Ferguson
 Fuchs, Elaine V.
 Greider, Carol W.
 Gross, Elizabeth Louise
 Guttman, Helene Augusta (Nathan)
 Hamilton, Alice
 Haschemeyer, Audrey E. V.
 Hay, Elizabeth Dexter
 Hollinshead, Ariel Cahill
 Horning, Marjorie G.
 Hubbard, Ruth (Hoffman)
 Jones, Mary Ellen
 Kaufman, Joyce (Jacobson)
 Klinman, Judith (Pollock)

Macy-Hoobler, Icie Gertrude
 Maling, Harriet Mylander
 Miller, Elizabeth Cavert
 Morgan, Agnes Fay
 Neufeld, Elizabeth (Fondal)
 Osborn, Mary Jane (Merten)
 Petermann, Mary Locke
 Ratner, Sarah
 Richardson, Jane S.
 Rolf, Ida P.
 Seibert, Florence Barbara
 Shockley, Dolores Cooper
 Shotwell, Odette Louise
 Simmonds, Sofia
 Singer, Maxine (Frank)
 Stadtman, Thressa Campbell
 Stanley, Louise
 Stearns, Genevieve
 Steitz, Joan (Argetsinger)
 Stubbe, JoAnne
 Tilghman, Shirley M.
 Tolbert, Margaret Ellen (Mayo)
 Vaughan, Martha
 Vennesland, Birgit
 Weisburger, Elizabeth Amy (Kreiser)
 Whitson, Peggy A.
 Wrinch, Dorothy Maud

Biomedical Sciences

Avery, Mary Ellen	Greider, Carol W.
Baetjer, Anna Medora	Griffin, Diane Edmund
Bartoshuk, Linda	Gross, Carol A. (Polinsky)
Benesch, Ruth Erica (Leroi)	Guthrie, Mary Jane
Blackburn, Elizabeth	Guttman, Helene Augusta (Nathan)
Bliss, Eleanor Albert	Harris, Mary (Styles)
Briscoe, Anne M.	Hay, Elizabeth Dexter
Broome, Claire Veronica	Hazen, Elizabeth Lee
Brown, Rachel Fuller	Hockfield, Susan
Brugge, Joan S.	Hollinshead, Ariel Cahill
Buck, Linda B.	Horning, Marjorie G.
Cobb, Jewel Plummer	Horstmann, Dorothy Millicent
Cohn, Mildred	Huang, Alice Shih-Hou
Colwell, Rita (Rossi)	Jones, Mary Ellen
Cori, Gerty Theresa Radnitz	Kaufman, Joyce (Jacobson)
Cowings, Patricia Suzanne	Kenyon, Cynthia J.
Daly, Marie Maynard	King, Mary-Claire
Dick, Gladys Rowena Henry	Koshland, Marian Elliott
Dunbar, Bonnie J.	Krim, Mathilde (Galland)
Elion, Gertrude Belle	Lancaster, Cleo
Estrin, Thelma Austern	Lancefield, Rebecca Craighill
Evans, Alice Catherine	Leeman, Susan (Epstein)
Farquhar, Marilyn (Gist)	Lesh-Laurie, Georgia Elizabeth
Ferguson, Angela Dorothea	L'Esperance, Elise Depew Strang
Fink, Kathryn Ferguson	Levi-Montalcini, Rita
Free, Helen (Murray)	Lewis, Margaret Adaline Reed
Friend, Charlotte	Lucid, Shannon (Wells)
Fuchs, Elaine V.	Maling, Harriet Mylander
Gayle, Helene Doris	Marrack, Philippa Charlotte
Giblett, Eloise Rosalie	McSherry, Diana Hartridge
Glusker, Jenny (Pickworth)	Mendenhall, Dorothy Reed
Gordon, Ruth Evelyn	Micheli-Tzanakou, Evangelia

Mielczarek, Eugenie Vorburger
Miller, Elizabeth Cavert
Mintz, Beatrice
Murray, Sandra Ann
Neufeld, Elizabeth (Fondal)
New, Maria (Iandolo)
Osborn, Mary Jane (Merten)
Pearce, Louise
Pert, Candace Dorinda (Bebe)
Petermann, Mary Locke
Pitelka, Dorothy Riggs
Pittman, Margaret
Pool, Judith Graham
Profet, Margie
Quimby, Edith Hinkley
Ramaley, Judith (Aitken)
Ramey, Estelle Rosemary White
Ranney, Helen Margaret
Ratner, Sarah
Rowley, Janet Davison
Sabin, Florence Rena
Sager, Ruth
Saif, Linda

Scharrer, Berta Vogel
Sedlak, Bonnie Joy
Seibert, Florence Barbara
Shapiro, Lucille (Cohen)
Shaw, Jane E.
Shockley, Dolores Cooper
Simmonds, Sofia
Sinkford, Jeanne Frances (Craig)
Stoll, Alice Mary
Stroud-Lee, F. Agnes Naranjo
Taussig, Helen Brooke
Vaughan, Martha
Villa-Komaroff, Lydia
Vitetta, Ellen Shapiro
Waelsch, Salome Gluecksohn
Weisburger, Elizabeth Amy (Kreiser)
Wexler, Nancy Sabin
Wilhelmi, Jane Anne Russell
Williams, Anna Wessels
Witkin, Evelyn Maisel
Woods, Geraldine (Pittman)
Yalow, Rosalyn Sussman

Botany (Plant Sciences)

Bennett, Joan Wennstrom
Berenbaum, May Roberta
Braun, (Emma) Lucy
Britton, Elizabeth Knight
Charles, Vera Katherine
Chase, (Mary) Agnes Meara
Chilton, Mary-Dell (Matchett)

Chory, Joanne
Davis, Margaret Bryan
Delmer, Deborah
Earle, Sylvia Alice
Eastwood, Alice
Esau, Katherine
Farr, Wanda Kirkbride

Fedoroff, Nina Vsevolod
Ferguson, Margaret Clay
Gantt, Elisabeth
Gerry, Eloise B.
Goldring, Winifred
Gross, Elizabeth Louise
Hart, Helen
Leopold, Estella Bergere
Long, Sharon (Rugel)
Mathias, Mildred Esther
McClintock, Barbara
McCoy, Elizabeth Florence

Moore, Emmeline
Patrick, Ruth
Patterson, Flora Wambaugh
Rissler, Jane Francina
Roberts, Edith Adelaide
Shields, Lora Mangum
Sommer, Anna Louise
Sweeney, (Eleanor) Beatrice Marcy
Tilden, Josephine Elizabeth
Vennesland, Birgit
Walbot, Virginia Elizabeth
Westcott, Cynthia

Chemistry

Anderson, Gloria (Long)
Benerito, Ruth Rogan
Berkowitz, Joan B.
Brill, Yvonne (Claeys)
Carr, Emma Perry
Caserio, Marjorie Constance (Beckett)
Cox, Geraldine Anne (Vang)
Dicciani, Nance Katherine
Drake, Elisabeth (Mertz)
Fitzroy, Nancy (Deloye)
Flanigen, Edith Marie
Fox, Marye Anne (Payne)
Free, Helen (Murray)
Gast, Alice P.
Glusker, Jenny (Pickworth)
Good, Mary (Lowe)
Grasselli (Brown), Jeanette
Greer, Sandra Charlene

Hahn, Dorothy Anna
Harrison, Anna Jane
Hoffman, Darleane (Christian)
Jeanes, Allene Rosalind
Karle, Isabella Helen Lugoski
Kaufman, Joyce (Jacobson)
Kwolek, Stephanie Louise
Libby, Leona Woods Marshall
MacLeod, Grace
Marlatt, Abby Lillian
Michel, Helen (Vaughn)
Mitchell, Helen Swift
Nightingale, Dorothy Virginia
Patrick, Jennie R.
Payne, Nellie Maria de Cottrell
Pennington, Mary Engle
Prichard, Diana (Garcia)
Reichmanis, Elsa

Rose, Mary Davies Swartz
Savitz, Maxine (Lazarus)
Schwan, Judith A.
Sherman, Patsy O'Connell
Shotwell, Odette Louise
Shreeve, Jean'ne Marie
Simon, Dorothy Martin

Solomon, Susan
Stiebeling, Hazel Katherine
Stubbe, JoAnne
Taylor, Kathleen Christine
Tesoro, Giuliana (Cavaglieri)
Thomas, Martha Jane (Bergin)

Computer Science & Information Technology

Bell, Gwen (Dru'yor)
Berezin, Evelyn
Berger, Marsha J.
Butler, Margaret K.
Conway, Lynn Ann
Davis, Ruth Margaret
Estrin, Thelma Austern
Goldberg, Adele
Goldwasser, Shafrira
Graham, Susan Lois
Granville, Evelyn (Boyd)
Greibach, Sheila Adele
Hamilton, Margaret
Hopper, Grace Murray
Hutchins, Sandra Elaine

Irwin, Mary Jane
Jones, Anita Katherine
Kempf, Martine
Kurtzig, Sandra L. (Brody)
Leveson, Nancy G.
Liskov, Barbara Huberman
McSherry, Diana Hartridge
Mitchell, Joan L.
Pour-El, Marian Boykan
Reichmanis, Elsa
Sammet, Jean Elaine
Shaw, Mary M.
Turtle, Sherry
Williams, Roberta
Wright, Margaret H.

Crystallography

Donnay, Gabrielle (Hamburger)
Glusker, Jenny (Pickworth)
Karle, Isabella Helen Lugoski

Richardson, Jane S.
Wood, Elizabeth Armstrong

Economics

Adelman, Irma Glicman
Hewlett, Sylvia Ann

Kanter, Rosabeth (Moss)
Kreps, Juanita (Morris)

Krueger, Anne (Osborn)
Ostrom, Elinor
Paté-Cornell, (Marie) Elisabeth
Lucienne
Rivlin, Alice (Mitchell)

Stern, Frances
Stokey, Nancy
Tyson, Laura (D'Andrea)
Wallace, Phyllis Ann
Whitman, Marina (von Neumann)

Engineering

Abriola, Linda M.
Agogino, Alice M.
Baranescu, Rodica
Benchmark, Leslie Ann (Freeman)
Berger, Marsha J.
Brill, Yvonne (Claeys)
Clarke, Edith
Cleave, Mary L.
Colmenares, Margarita H.
Conway, Lynn Ann
Conwell, Esther Marly
Darden, Christine V. Mann
Davis, Ruth Margaret
De Planque, E. Gail
Dicciani, Nance Katherine
Drake, Elisabeth (Mertz)
Dresselhaus, Mildred (Spiewak)
Edwards, Helen Thom
Estrin, Thelma Austern
Fitzroy, Nancy (Deloye)
Flugge Lotz, Irmgard
Garmire, Elsa (Meints)
Gast, Alice P.
Gilbreth, Lillian E. Moller
Goldwasser, Shafrira

Good, Mary (Lowe)
Graham, Susan Lois
Hamilton, Margaret
Hicks, Beatrice Alice
Hutchins, Sandra Elaine
Hwang, Jennie S.
Irwin, Mary Jane
Jackson, Shirley Ann
Johnson, Barbara Crawford
Johnston, Mary Helen
Jones, Anita Katherine
Kempf, Martine
Kuhlmann-Wilsdorf, Doris
Levelt-Sengers, Johanna Maria Henrica
Liskov, Barbara Huberman
Matthews, Alva T.
Mitchell, Mildred Bessie
Napadensky, Hyla Sarane (Siegel)
Nichols, Roberta J.
Ochoa, Ellen
Paté-Cornell, (Marie) Elisabeth
Lucienne
Patrick, Jennie R.
Peden, Irene (Carswell)
Pressman, Ada Irene

Rand, (Marie) Gertrude
 Resnik, Judith A.
 Roy, Della Martin
 Savitz, Maxine (Lazarus)
 Schwan, Judith A.

Shaw, Mary M.
 Taylor, Kathleen Christine
 Townsend, Marjorie Rhodes
 Widnall, Sheila (Evans)
 Wu, Ying-Chu (Lin) Susan

Environmental Sciences & Ecology

Abriola, Linda M.
 Ancker-Johnson, Betsy
 Anderson, Mary P.
 Baetjer, Anna Medora
 Beattie, Mollie Hanna
 Berenbaum, May Roberta
 Berkowitz, Joan B.
 Bonta, Marcia (Myers)
 Braun, (Emma) Lucy
 Braun, Annette Frances
 Cady, Bertha Louise Chapman
 Caldicott, Helen Mary (Broinowski)
 Carson, Rachel Louise
 Cleave, Mary L.
 Colmenares, Margarita H.
 Cox, Geraldine Anne (Vang)
 Davis, Margaret Bryan
 DeFries, Ruth
 Drake, Elisabeth (Mertz)
 Ehrlich, Anne (Fitzhugh) Howland
 Grasselli (Brown), Jeanette
 Hamerstrom, Frances (Flint)
 Hamilton, Alice
 Haschemeyer, Audrey E. V.
 LaBastille, Anne

Leopold, Estella Bergere
 Libby, Leona Woods Marshall
 Lubchenco, Jane
 Margulis, Lynn (Alexander)
 Matson, Pamela Anne
 McCammon, Helen Mary (Choman)
 McCoy, Elizabeth Florence
 McWhinnie, Mary Alice
 Moore, Emmeline
 Morgan, Ann Haven
 Nichols, Roberta J.
 Patch, Edith Marion
 Patrick, Ruth
 Ray, (Marguerite) Dixy Lee
 Rissler, Jane Francina
 Roberts, Edith Adelaide
 Savitz, Maxine (Lazarus)
 Scott, Juanita (Simons)
 Shields, Lora Mangum
 Shotwell, Odette Louise
 Solomon, Susan
 Stickel, Lucille Farrier
 Taylor, Kathleen Christine
 Tilden, Josephine Elizabeth
 Weisburger, Elizabeth Amy (Kreiser)

Genetics

Adams, (Amy) Elizabeth
Altmann, Margaret
Bennett, Joan Wennstrom
Blackburn, Elizabeth
Carothers, (Estrella) Eleanor
Chilton, Mary-Dell (Matchett)
Fausto-Sterling, Anne
Fedoroff, Nina Vsevolod
Fuchs, Elaine V.
Fuchs, Elaine V.
Giblett, Eloise Rosalie
Greider, Carol W.
Harris, Mary (Styles)
Hoy, Marjorie Ann (Wolf)
Huang, Alice Shih-Hou
Hubbard, Ruth (Hoffman)
Jones, Mary Ellen
Kidwell, Margaret Gale
Kimble, Judith
King, Helen Dean
King, Mary-Claire
Krim, Mathilde (Galland)

Long, Sharon (Rugel)
Macklin, Madge Thurlow
Margulis, Lynn (Alexander)
McClintock, Barbara
Mintz, Beatrice
Nelkin, Dorothy (Wolfers)
Neufeld, Elizabeth (Fondal)
Pardue, Mary Lou
Rissler, Jane Francina
Rowley, Janet Davison
Russell, Elizabeth Shull
Sager, Ruth
Shapiro, Lucille (Cohen)
Singer, Maxine (Frank)
Steitz, Joan (Argetsinger)
Stroud-Lee, F. Agnes Naranjo
Tilghman, Shirley M.
Villa-Komaroff, Lydia
Waelsch, Salome Gluecksohn
Walbot, Virginia Elizabeth
Wexler, Nancy Sabin
Witkin, Evelyn Maisel

Geography

Baber, Mary Arizona “Zonia”
Bell, Gwen (Dru’yor)
Boyd, Louise Arner
DeFries, Ruth

Fischer, Irene (Kaminka)
Semple, Ellen Churchill
Tharp, Marie

Geology

Anderson, Mary P.
Banfield, Jillian F.

Bascom, Florence
Bunce, Elizabeth Thompson

Davis, Margaret Bryan
 Donnay, Gabrielle (Hamburger)
 Dreschhoff, Gisela Auguste-Marie
 Fowler Billings, Katharine Stevens
 Gardner, Julia Anna
 Goldring, Winifred
 Herzenberg, Caroline Stuart
 (Littlejohn)
 Kieffer, Susan Werner
 Knopf, Eleanora Frances Bliss
 Lochman Balk, Christina
 Loeblich, Helen Nina Tappan
 Marvin, Ursula Bailey
 Maury, Carlotta Joaquina
 McCammon, Helen Mary (Choman)
 McNutt, Marcia Kemper

Michel, Helen (Vaughn)
 Navrotsky, Alexandra A. S.
 Ocampo, Adriana C.
 Ogilvie, Ida Helen
 Owens, Joan Murrell
 Palmer, Katherine Hilton Van Winkle
 Peden, Irene (Carswell)
 Romanowicz, Barbara
 Roy, Della Martin
 Schwarzer, Theresa Flynn
 Sullivan, Kathryn D.
 Talbot, Mignon
 Tharp, Marie
 Wood, Elizabeth Armstrong
 Zoback, Mary Lou

Mathematics

Bates, Grace Elizabeth
 Berger, Marsha J.
 Bertell, Rosalie
 Butler, Margaret K.
 Clarke, Edith
 Cox, Gertrude Mary
 Daubechies, Ingrid
 Davis, Ruth Margaret
 Fischer, Irene (Kaminka)
 Flugge Lotz, Irmgard
 Geiringer (Von Mises), Hilda
 Granville, Evelyn (Boyd)
 Greibach, Sheila Adele
 Hazlett, Olive Clio
 Hopper, Grace Murray

Karp, Carol Ruth (Vander Velde)
 Kopell, Nancy J.
 Luchins, Edith Hirsch
 Menken, Jane Ava (Golubitsky)
 Morawetz, Cathleen (Synge)
 Partee, Barbara (Hall)
 Pour-El, Marian Boykan
 Rees, Mina Spiegel
 Robinson, Julia Bowman
 Rosenblatt, Joan (Raup)
 Rudin, Mary Ellen (Estill)
 Sammet, Jean Elaine
 Taussky-Todd, Olga
 Uhlenbeck, Karen (Keskulla)
 Wheeler, Anna Johnson Pell

Wheeler, Mary F.
Wright, Margaret H.

Wrinch, Dorothy Maud

Medicine

Apgar, Virginia
Avery, Mary Ellen
Broome, Claire Veronica
Caldicott, Helen Mary (Broinowski)
Crosby, Elizabeth Caroline
Delgado, Jane L.
Densen-Gerber, Judianne
Dick, Gladys Rowena Henry
Elders, (Minnie) Joycelyn (Jones)
Ferguson, Angela Dorothea
Fisher, Anna L.
Gayle, Helene Doris
Graham, Frances (Keesler)
Harris, Jean Louise
Harrison-Ross, Phyllis Ann
Healy, Bernadine Patricia
Horstmann, Dorothy Millicent
Hyde, Ida Henrietta
Jackson, Jacquelyne Mary (Johnson)
Jemison, Mae Carol
Kübler-Ross, Elisabeth
Lancaster, Cleo
Leeman, Susan (Epstein)
L'Esperance, Elise Depew Strang
Long, Irene (Duhart)
Love, Susan M.
Lubic, Ruth (Watson)

Macklin, Madge Thurlow
McSherry, Diana Hartridge
Mendenhall, Dorothy Reed
New, Maria (Iandolo)
Nielsen, Jerri Lin
Northrup, Christiane
Novello, Antonia (Coello)
Pearce, Louise
Pert, Candace Dorinda (Bebe)
Pool, Judith Graham
Profet, Margie
Ramaley, Judith (Aitken)
Ramey, Estelle Rosemary White
Rand, (Marie) Gertrude
Ranney, Helen Margaret
Rolf, Ida P.
Rowley, Janet Davison
Sabin, Florence Rena
Seddon, Margaret Rhea
Shalala, Donna Edna
Sinkford, Jeanne Frances (Craig)
Spurlock, Jeanne
Taussig, Helen Brooke
Wattleton, (Alyce) Faye
Wilhelmi, Jane Anne Russell
Williams, Anna Wessels

Meteorology

Ackerman, Bernice

Austin, Pauline Morrow

Kalnay, Eugenia

Ledley, Tamara (Shapiro)

LeMone, Margaret Anne

Simpson, Joanne Malkus (Gerould)

Van Straten, Florence Wilhemina

Neurosciences

Brown, Barbara B.

Crosby, Elizabeth Caroline

Diamond, Marian Cleeves

Estrin, Thelma Austern

Fromkin, Victoria Alexandria
(Landish)

Goldman-Rakic, Patricia

Graybiel, Ann Martin

Hockfield, Susan

Jameson, Dorothea A.

Jan, Lily

Kanwisher, Nancy

Leeman, Susan (Epstein)

Levi Montalcini, Rita

Micheli-Tzanakou, Evangelia

Pert, Candace Dorinda (Bebe)

Spelke, Elizabeth

Treisman, Anne

Wexler, Nancy Sabin

Nutrition & Home Economics

Aberle, Sophie Bledsoe

Brody, Jane Ellen

Brooks, Carolyn (Branch)

Calloway, Doris (Howes)

Carey, Susan E.

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Chronology

- 1902** **Florence Sabin** appointed the first female faculty member at Johns Hopkins Medical School
- 1903** Marie Curie shares Nobel Prize in Physics with her husband, Pierre Curie, and Antoine Henri Becquerel
- 1911** Marie Curie awarded Nobel Prize in Chemistry
- 1919** Toxicologist **Alice Hamilton** appointed to faculty of Harvard Medical School, the first female faculty member in any Harvard department
- 1920** American women gain the right to vote with passage of the Nineteenth Amendment to the U.S. Constitution
- 1921** Margaret Sanger founds American Birth Control League
- 1923** Chemist **Louise Stanley** becomes head of the Bureau of Home Economics, the first woman to lead a division at the U.S. Department of Agriculture (USDA)
- 1925** **Florence Sabin** is the first woman elected to the National Academy of Sciences
- 1928** Anthropologist **Margaret Mead** publishes *Coming of Age in Samoa*
- 1935** Irène Joliot-Curie, daughter of Pierre and Marie Curie, shares Nobel Prize in Chemistry with her husband, Frederic Joliot
- 1937** Mount Holyoke chemistry professor **Emma Carr** is the first recipient of the Garvan Medal of the American Chemical Society, awarded to a woman chemist each year
- 1940** **Elsie Clews Parsons** named the first female president of the American Anthropological Association

- 1942** The U.S. government begins secret project known as the Manhattan Project to develop nuclear weapons, employing many female scientists, engineers, and researchers
- 1943** Committee of the U.S. Food and Nutrition Board (FNB), chaired by nutritionist **Lydia Roberts** and including several other female researchers, publishes new Recommended Dietary Allowances (RDA) guidelines for nutrients and vitamins
- 1947** Biochemist **Gerty Cori** shares Nobel Prize in Physiology or Medicine with her husband, Carl F. Cori
- 1948** Electrical engineer and mathematician **Edith Clarke** is first woman elected a fellow of the American Institute of Electrical Engineers
- 1950** Physician, nutritionist, and anthropologist **Sophie Aberle** is first female member of the National Science Board
- Rachel Brown** and **Elizabeth Hazen** develop the antibiotic nystatin
- Beatrice Hicks** helps found the Society of Women Engineers (SWE) and serves as first president
- 1953** Physician **Virginia Apgar** publishes her Apgar scale, which becomes standard test for assessing responses and health of babies at birth
- 1955** Chemist **Patsy Sherman** is co-inventor of Scotchgard Fabric Protector for 3M
- 1958** U.S. government creates National Aeronautics and Space Administration (NASA)
- 1960** The U.S. Food and Drug Administration (FDA) approves a combined hormone oral contraceptive (“the pill”)
- 1962** Environmental biologist **Rachel Carson** publishes the book *Silent Spring*
- Nobel Prize in Physiology or Medicine is awarded to Francis Crick, James Watson, and Maurice Wilkins for the discovery of DNA, research to which British crystallographer Rosalind Franklin also contributed
- 1963** Russian cosmonaut Valentina Tereshkova is the first woman in space
- Maria Goeppert-Mayer** is co-recipient of Nobel Prize in Physics

- 1964** British chemist Dorothy Crowfoot Hodgkin receives Nobel Prize in Chemistry
- U.S. Congress passes Civil Rights Act, which includes legislation against sex and race discrimination in employment and federal programs
- 1965** Chemist **Stephanie Kwolek** develops Kevlar synthetic material for DuPont
- Engineer and industrial psychologist **Lillian Gilbreth** is first woman elected to National Academy of Engineering
- Endocrinologist **Helen Taussig** named first woman president of the American Heart Association
- 1966** National Organization for Women (NOW) is founded
- 1968** Biological and environmental scientists **Anne Ehrlich** and Paul Ehrlich publish the controversial book *The Population Bomb*
- 1970** Economist **Marina v. N. Whitman** is first woman named to the President's Council of Economic Advisors
- 1971** **Mina Rees** named first female president of the American Association for the Advancement of Science (AAAS)
- 1972** Title IX of the Educational Amendments to the Civil Rights Act prohibits discrimination on the basis of sex in federally funded educational programs
- 1973** The book *Our Bodies, Ourselves* is published by Boston Women's Health Book Collective
- 1976** **Margaret Burbidge** is named first woman president of the American Astronomical Society
- 1977** Economist **Juanita Kreps** is named first woman secretary of the U.S. Department of Commerce
- Rosalyn Yalow** is co-recipient of Nobel Prize in Physiology or Medicine
- Psychologist **Carolyn Payton** is named first woman director of the Peace Corps
- 1978** NASA opens astronaut program to first group of six women
- Organic chemist **Anna Harrison** elected the first woman president of the American Chemical Society

- 1981** The U.S. Centers for Disease Control first identifies the HIV virus that causes AIDS
NASA launches first space shuttle
- 1983** **Sally Ride** is first American woman in space
Julia Robinson is first woman elected president of the American Mathematical Society
Geneticist **Barbara McClintock** receives Nobel Prize in Physiology or Medicine
- 1986** Neurologist **Rita Levi-Montalcini** is co-recipient of Nobel Prize in Physiology or Medicine
Nancy Fitzroy is first female president of American Society of Mechanical Engineers
- 1987** Anthropologist **Johnnetta Cole** is first black woman president of Spelman College, the United States' oldest historically black college for women
- 1988** **Gertrude Elion** is co-recipient of Nobel Prize in Physiology or Medicine
- 1990** Pediatrician **Antonia Novello** is named first female (and first Hispanic) U.S. Surgeon General
Hubble Space Telescope is launched
- 1991** Cardiologist **Bernadine Healy** is first woman to head the National Institutes of Health
- 1992** American Association of University Women (AAUW) publishes report on *How Schools Shortchange Girls*
- 1993** Economist **Alice Rivlin** named first director of the new Congressional Budget Office
Aeronautics engineer **Sheila Widnall** named Secretary of the U.S. Air Force, the first woman to lead a branch of the military
Pediatrician **Joycelyn Elders** is second woman (and first African American) to be named U.S. Surgeon General
Ms. Foundation begins "Take Our Daughters to Work Day"
- 1995** German biologist Christiane Nüsslein-Volhard is co-recipient of Nobel Prize in Physiology or Medicine

- Theoretical physicist **Shirley Ann Jackson** is first woman to serve as chair of the U.S. Nuclear Regulatory Commission (NRC)
- 1998** Marine scientist **Rita Colwell** named first female director of the National Science Foundation (NSF)
- Jane Henney named first female Commissioner of the U.S. Food and Drug Administration (FDA)
- 1999** Physicist **Shirley Ann Jackson** becomes first female president of Rensselaer Polytechnic Institute
- 2000** **Rodica Baranescu** elected first woman president of the Society of Automotive Engineers (SAE)
- 2001** U.S. National Institutes of Health (NIH) establishes Office of Women to focus medical studies and research specific to women
- Biologist **Shirley M. Tilghman** is named first female president of Princeton University
- Physicist **Shirley Ann Jackson** is first African American woman to be elected to the National Academy of Engineering
- 2002** **Peggy Whitson** is first woman commander of the International Space Station
- 2003** A draft of the full Human Genome Project is completed
- 2004** Neurobiologist **Susan Hockfield** is named first woman president of the Massachusetts Institute of Technology (MIT)
- Biologist **Linda Buck** is co-recipient of the Nobel Prize in Physiology or Medicine
- 2005** Harvard University President Lawrence Summers delivers controversial remarks at conference on “Diversifying the Science & Engineering Workforce”
- 2006** Chemical engineer **Alice P. Gast** named first female president of Lehigh University
- Human papillomavirus (HPV) vaccine is made available for prevention of cervical cancer
- 2007** Astrophysicist **France Cordova** is named first female president of Purdue University

2008 French virologist Françoise Barré-Sinoussi is co-recipient of Nobel Prize in Physiology or Medicine

Karen LuJean Nyberg is the fiftieth American woman in space

Oceanographer **Susan Avery** is named first female director of the Woods Hole Oceanographic Institution

2009 Marine ecologist **Jane Lubchenco** is named head of the National Oceanic and Atmospheric Administration (NOAA)

Geophysicist **Marcia McNutt** is named head of the U.S. Geological Survey (USGS)

Biologists **Carol Greider** and **Elizabeth Blackburn** are co-recipients of Nobel Prize in Physiology or Medicine

Elinor Ostrom is co-recipient of Nobel Prize in Economics, the first woman Nobel Laureate in that category

Israeli scientist Ada Yonath is co-recipient of Nobel Prize in Chemistry

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